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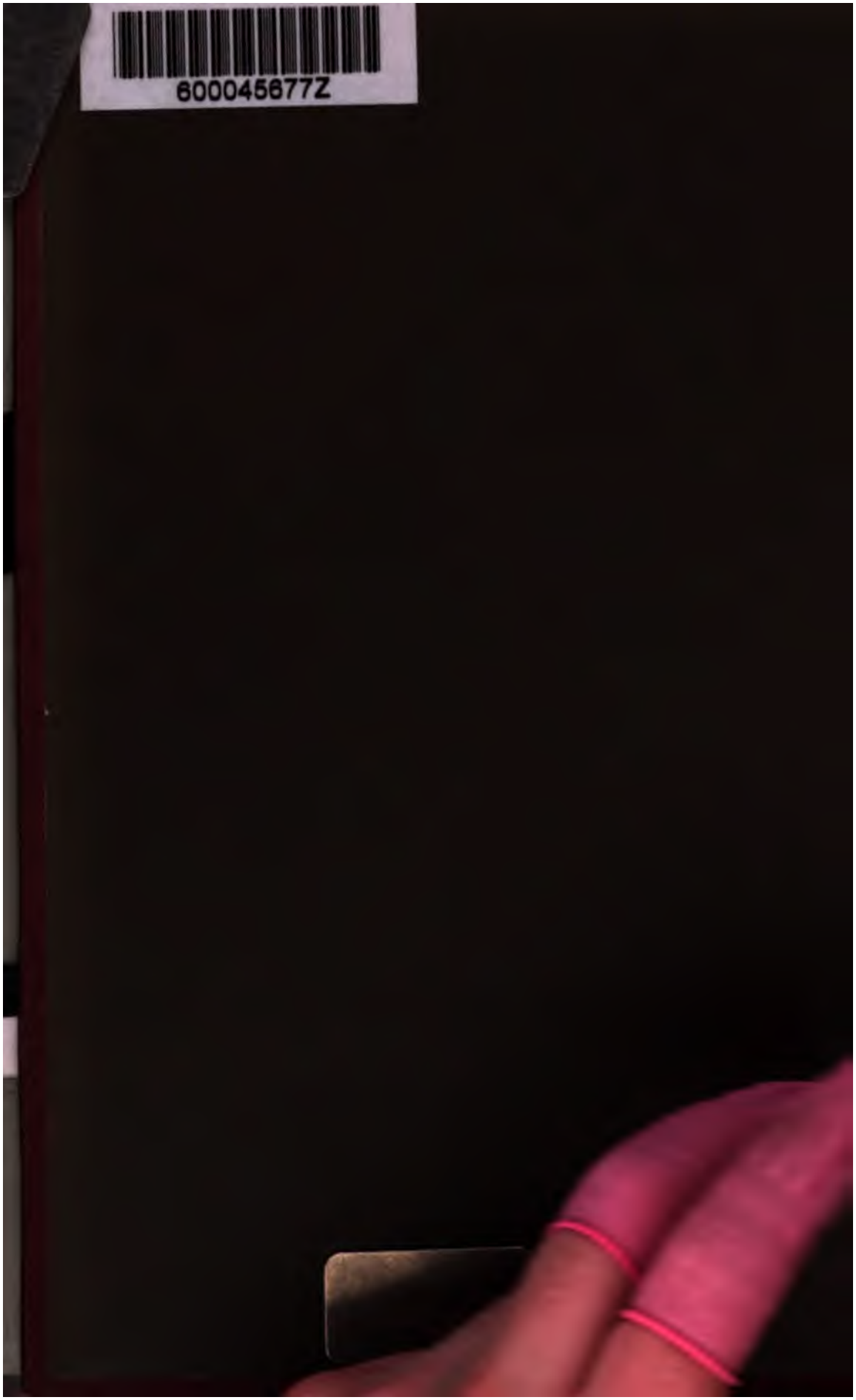
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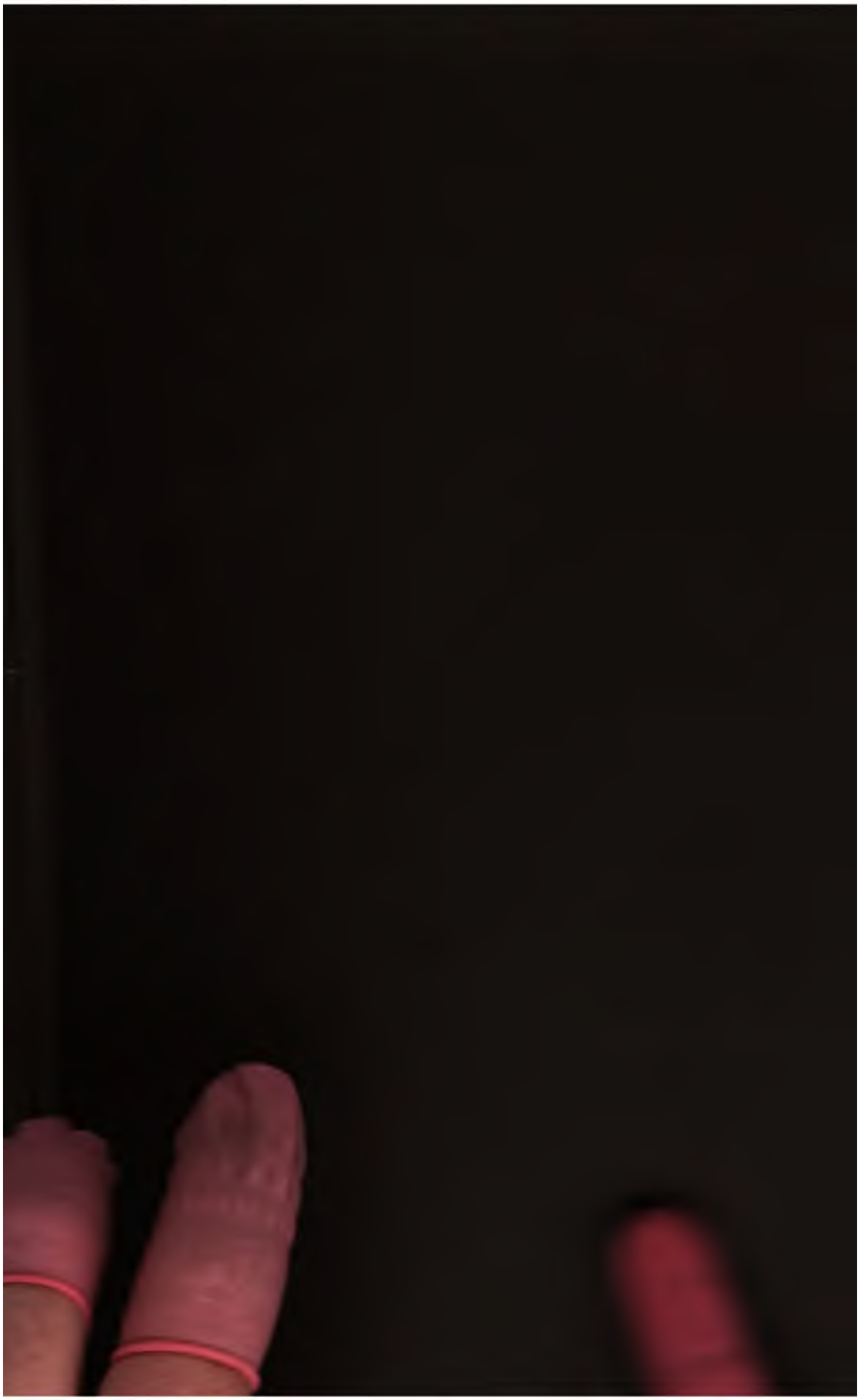
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SURGERY

A TREATISE ON

SURGERY

ITS PRINCIPLES AND PRACTICE

By T. HOLMES, M.A. Cantab.

SURGEON TO ST GEORGE'S HOSPITAL

WITH FOUR HUNDRED AND EIGHTEEN ILLUSTRATIONS

CHIEFLY BY DR WESTMACOTT

'MILLE MALI SPECIES'

FOURTH EDITION

LONDON

SMITH, ELDER, & CO., 15 WATERLOO PLACE

1884

160. c. d. 8

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PREFACE

TO

THE FOURTH EDITION.

THE only changes which have been made in this edition are such as the constant improvements in the practice of Surgery necessitate in every new edition of a text-book, at however short an interval it may be reissued. The whole work has, however, been carefully revised and compared with the third edition of the 'System of Surgery,' of which free use has been made, as was made of the second edition in the composition of the original work.

The anticipation which I expressed in the Preface to the former edition, of being able to express, in this, a more confident opinion on 'the new pathological speculations with which the name of Koch is now chiefly associated,' has not been realised. The presence of bacteria, or bacilli, has been alleged in numerous morbid products, and proved in some, to the satisfaction of many competent pathologists; but the origin and significance of these bodies furnish still abundant matter for controversy.

Meanwhile I think it may be said with truth that the art of Surgery is advancing with rapid strides, and that surgical education is advancing with corresponding rapidity. I trust I am not too presumptuous in hoping that this book, as far as its scope permits, is a faithful reflection of this advance.

PREFACE

TO

THE FIRST EDITION.

I NEED say little by way of preface to this volume, which, indeed, speaks for itself. It is an attempt to represent the present condition of Surgery, as it is practised in this country, by a treatise which shall be not unworthy to rank with the other excellent text-books in use in our schools. I have intended this book to be to some extent an introduction to the more elaborate 'System of Surgery' of which I am the editor, and have freely used the treatises of that System in composing the various chapters; and when any quotations are made, the source of which is not distinctly acknowledged, it will be understood that they are taken from thence. At the same time I have not servilely followed the teaching even of those authorities; and I hope the reader will find throughout the book sufficient evidence of that personal experience of the various exigencies of surgery which can alone justify an author in attempting the difficult task of writing on the general subject of surgical theory and practice. The task is indeed difficult. It is not only the immense number of topics, and the endless details of all of them—though necessarily some of these topics must be less familiar to any single surgeon (however wide his experience) than others are, and though it is hardly possible but that some of the details should escape the writer's attention—but, added to this, the necessary conditions of space press hardly on the writer of a surgical text-book. Though this volume extends to over 900 pages, the space allotted to each topic only permits of a brief and, I fear, far too meagre account of each, and leaves hardly any room at all to discuss varying opinions and rival

suggestions of practice. My endeavour has been to give a plain and practical account of each surgical injury and disease, and of the treatment which is most commonly advisable. For the minuter details of pathology I must refer the reader to some of the many admirable works on that subject; and for fuller disquisitions on treatment either to the essays in the 'System of Surgery' or to the authors quoted in the text and referred to in the index of authors.

I have to acknowledge with grateful thanks the liberality with which the rich store of material contained in the museum and case-books of St. George's Hospital has been put at my disposal. It is, of course, from the school of this hospital, in which I have studied and practised surgery for over a quarter of a century, that my illustrations and my teaching have been chiefly drawn; but I have not neglected the teaching of other British schools; nor, although I have intended this work to be an exposition especially of British surgery, have I failed to refer, as far as my information and my space allowed, to the works of American and Continental surgeons.

For the illustrations I have been indebted mainly to Dr. Westmacott, to whom my warm thanks are due for the great interest he has taken in the work and the pains he has spent upon it. Many of the minor illustrations were, however, drawn by one of my pupils, Mr. F. D. Drewitt, whose intelligent and able assistance it is my duty to acknowledge as it deserves; nor must I omit to thank Mr. Evans, the engraver of the woodcuts, for the great care which he has bestowed upon them, and for several of the diagrams which he has drawn under my direction.

I have thought it necessary to comprise in this treatise all the diseases which are included under the title 'surgical,' so that chapters will be found on diseases of the eye, ear, and skin. In treating the first-mentioned subject I have availed myself of the able assistance of my colleague Mr. Carter; as it is many years since I have personally engaged in ophthalmic practice, and it is only from recent practice that a branch of surgery can be taught which has been so greatly modified by recent discoveries. But I hold that a knowledge of the main principles of diagnosis and treatment ought to be possessed by every surgeon in the case of diseases of the organs of the special senses quite as much as those of the rest of the body. Among the many injuries which the

curse of specialism has inflicted equally on the profession and the public, not the least has been the neglect of the diseases of these organs which some practitioners and many students seem almost to regard as natural. I am happy to think that in the subject of ophthalmic surgery my readers will have the benefit of so competent a guide as Mr. Carter. The chapter on Diseases of the Ear is necessarily very short, and is intended only to point out the leading facts in Aural Surgery, and those methods of treatment with which every practitioner ought to be familiar. I must express my obligation to Mr. Dalby, who has been so kind as to peruse it and correct some of its most obvious defects.

I must now submit this book to the judgment of my professional brethren, though fully conscious of its many imperfections. I fear that as we advance in life we feel more and more the difficulty of coming up to our own expectations in any enterprise of importance, and the truth of the old saying, 'Quid tam dextro pede concipis ut te conatus non pœniteat votique peracti?'

GREAT CUMBERLAND PLACE:
October 1875.

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Inflammatory swelling.

The increased supply of blood in the part must necessarily cause *swelling*, but another and the main cause of swelling is the extravasation which takes place in the parenchyma of the inflamed part as the impediment to the blood-stream increases. When the blood is flowing naturally, through a transparent web, there will always be seen around the central column of the blood-corpuscles an external part of the vessel's area which looks as if it were empty —i.e. where only the transparent serum is circulating—and, if the individual blood-discs can be seen, they will be observed to be separate from each other. This mutual repulsion between the blood-corpuscles and the wall of the vessel is abolished by inflammation. The corpuscles adhere to each other and to the wall of the vessel, and soon the white corpuscles of the blood are seen to have passed through the membrane and to have moved into the parenchymatous tissue. The serum also transudes, and the red globules are here and there found to be extravasated. The name of *lymph* is given to this inflammatory exudation, consisting mainly of the cells which are formed out of the leucocytes in their various stages of development, and partly of serous fluid. Red blood-globules may be intermingled; but this is accidental. The term 'fibrine' is also often employed as synonymous with lymph. In the early stages of inflammation the exuded fluid is removed in great measure by the lymphatics. Lassar's experiments, quoted by Sanderson ('Syst. of Surg.' 3rd ed. i. 75,) show the great increase in the fluid discharged by the lymphatics of an inflamed limb as compared with its healthy fellow, and also the increase in the solid contents of inflammatory over healthy lymph.

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The temperature of an inflamed part is raised, to the sensations of the patient himself generally, and always to the thermometer, This is familiar to everybody from his own experience, and some increase of temperature must evidently be caused by the mere loading of the part with blood. But it seems, from recent experiments, that not only is the part more richly supplied with blood at the usual temperature of healthy blood, but that heat is generated in the inflamed part, and thus the temperature of the blood at the focus of inflammation is raised above that of the rest of the blood. John Hunter taught the reverse of this doctrine. He quotes some experiments which he made [1] to prove that the temperature of an inflamed part never rises above that of the blood in the heart; but these experiments were not made with sufficiently delicate means of observation; and Mr. Simon [2] has put on record a series of thermo-electrical observations of inflamed parts whereby he has proved—'1. That the *arterial* blood supplied to an inflamed limb is less warm than the focus of inflammation itself; 2. That the *venous* blood returning from an inflamed limb, though less warm than the focus of inflammation, is warmer than the arterial blood supplied to the limb; and,

tom. Any cause which prevents the return of the venous blood—a ligature round the limb, a tumour in the course of the vein, even prolonged standing or exposure to heat, besides innumerable other similar conditions—may determine passive congestion. Similarly it may be said with respect to many of the phenomena of inflammation, and even with respect to inflammation itself, that it is very difficult, if not impossible, to draw an accurate limit between health and disease. Determination of blood, or active congestion, is an element in thousands of the actions of daily life. Exudation of the plasma of the blood almost certainly takes place as a physiological process, and exudation of the leucocytes very probably does so. Inflammation itself is only vital action perverted by some injury: and who is to say where the limit is between the injuries which are and those which are not compatible with health?

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Inflammatory pain.

The pain of inflammation varies very considerably. Even in inflammation of the largest and the most vital organs there may be little or no pain, while in some of the smallest (such as the fingers) the pain may be intolerable. Much depends on the extensibility of the inflamed part; thus the acute pain in whitlow and in orchitis is explained by the resistance offered to the increase of swelling by the sheath of the tendon, and by the tunica albuginea respectively. Still more depends on the peculiar sensibility of the organ. The physical cause of pain it is often impossible to ascertain. Pain is often greater in diseases when there is no evidence of inflammation (as in neuralgia) than when inflammation is not only dangerous but even fatal (as in gangrene of the lung); and most severe pain may be experienced, as everyone knows, in conditions of the body which are compatible with perfect health. Yet this does not destroy the great importance of pain as a symptom of disease in general, and of inflammation in particular. It only shows that in clinical investigations it is necessary to take account of all the circumstances of the case—not of one only. The persistence of pain in any given part ought to induce the surgeon to examine closely the condition of the general system (pulse, tongue, temperature, and secretions) and of the part itself (as to redness, swelling, heat, and the functions of the organ), and on such an examination a secure diagnosis can almost always be founded.

Inflammatory and traumatic fever.

Inflammation, when extensive or very violent, is accompanied by general fever, which is variously designated as 'inflammatory,' 'traumatic,' 'surgical,' 'irritative,' &c. The condition necessary for its production appears to be the overheating of the blood, as stated above, and its leading symptom therefore is the rise of temperature of the whole body. Hence the importance of the thermometrical observations which are now so generally taken in surgical as well as in medical cases.

As typical of inflammatory fever, for surgical purposes, I shall select that form which follows on a severe wound.[2]

Traumatic fever commences usually within twenty-four hours of the receipt of the injury, and sometimes dates almost from the moment of its receipt. The patient feels hot and uncomfortable, with occasional intervals of chilliness, sometimes amounting to definite rigor. He is thirsty and restless, with a rapid and perhaps hard and bounding pulse, furred tongue, hot and dry

[1] I do not mean that all the phenomena of inflammatory or traumatic fever depend on the mere rise of temperature of the blood, but as the inflammatory heat rises so are these phenomena developed. Whether they depend on the rise of temperature, or whether they and it have a common cause, is another question. The reader will find the various theoretical views as to the cause of development of inflammatory heat discussed by Billroth, as quoted on page 17; but Mr. Simon's essay gives the best practical account of the matter.

[2] A good opportunity of watching the phenomena of traumatic fever is furnished by any great operation, such as an amputation, undertaken for the removal of a chronic disease on a person previously in good general health. The state of the pulse, tongue, and secretions, and the normal temperature should be carefully noted for the two or three days preceding the operation; and morning and evening observations should be regularly taken after it until the temperature and all other matters observed have returned to the condition of health.

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SURGERY:

ITS PRINCIPLES AND PRACTICE.

CHAPTER I.

INFLAMMATION AND THE PROCESS OF UNION IN SOFT PARTS—TRAUMATIC FEVER—DRESSING OF WOUNDS.

INFLAMMATION is the name given to a perverted vital action,[1] one of the leading features of which, as the name implies, is the production of unnatural *heat* in the part. Although the researches of modern pathologists have greatly advanced our knowledge of the essential phenomena of the process of inflammation, yet, for practical purposes, I think it is better to commence the study of inflammation from the old definition of it by its four great symptoms, 'redness, swelling, heat, and pain.'[2]

Inflammatory redness. Congestion.

The redness depends on *congestion*, or the loading of the inflamed part with blood; and this congestion is spoken of in surgical language as *active*, i.e. due to an increased supply, or *passive*, i.e. due to diminished power of circulation or impeded return of blood. Congestion is best studied, either in a superficial part of the human body or in the web of a frog's foot or other transparent part, spread out under the microscope. Thus, in the ocular conjunctiva, after the lodgment of a grain of dust in the eye, red vessels will be seen shooting over parts which before were perfectly white, and soon the membrane, which in its natural state was transparent and imperceptible, is converted at the part injured into a pulpy mass of dilated vessels, from which a copious discharge of fluid exudes. In the frog's foot, on the application of an irritant, the small arteries dilate, the stream of blood flows more rapidly, the dilatation extends to the capillaries and then to the veins; next the stream of blood moves more slowly, and finally it oscillates and stops entirely. The period of dilated arteries and increased stream is that of 'active congestion,' or determination of blood; that of dilated veins and diminished movement, 'passive congestion.'[3] The stoppage of the stream receives the name of 'the inflammatory stasis.'

[1] In Dr. Burdon Sanderson's words, 'Inflammation is the aggregate of those results which manifest themselves in an injured part as the immediate consequences of the injurious action to which it has been exposed' ('Lancet,' January 22, 1876). Of course in such a definition the word 'injury' is taken in its widest sense, not limited to traumatic injury.

[2] This is Celsus's definition: 'Notæ inflammationis sunt quatuor, rubor et tumor, cum calore et dolore.'

[3] Passive congestion, however, is not always, nor indeed usually, an inflammatory symp-

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As typical of inflammatory fever, for surgical purposes, I shall select that form which follows on a severe wound.[2]

Traumatic fever commences usually within twenty-four hours of the receipt of the injury, and sometimes dates almost from the moment of its receipt. The patient feels hot and uncomfortable, with occasional intervals of chilliness, sometimes amounting to definite rigor. He is thirsty and restless, with a rapid and perhaps hard and bounding pulse, furred tongue, hot and dry

[1] I do not mean that all the phenomena of inflammatory or traumatic fever depend on the mere rise of temperature of the blood, but as the inflammatory heat rises so are these phenomena developed. Whether they depend on the rise of temperature, or whether they and it have a common cause, is another question. The reader will find the various theoretical views as to the cause of development of inflammatory heat discussed by Billroth, as quoted on page 17; but Mr. Simon's essay gives the best practical account of the matter.

[2] A good opportunity of watching the phenomena of traumatic fever is furnished by any great operation, such as an amputation, undertaken for the removal of a chronic disease on a person previously in good general health. The state of the pulse, tongue, and secretions, and the normal temperature should be carefully noted for the two or three days preceding the operation; and morning and evening observations should be regularly taken after it until the temperature and all other matters observed have returned to the condition of health.

skin, scanty and high-coloured urine, constipated bowels, flushed face, headache, and loss of appetite. The symptoms are aggravated towards night, when a definite rise of temperature can usually be noted. Coincident with any abrupt and very considerable elevation of the heat of the blood (say more than 2° F.) there is almost certain to be a rigor. In uncomplicated cases of traumatic fever the symptoms will probably begin to decline from about the second day after its commencement, and will have entirely subsided by the fifth, sixth, or seventh day; but there is much variety both as to the period at which it attains its climax (or 'fastigium,' as it is technically called) and as to its total duration. The first appearance of decrease is very generally coincident with the occurrence of suppuration. After the subsidence of the primary attack of fever a secondary attack sometimes occurs, apart from any other complication, but usually the reappearance of fever denotes the occurrence of some of the complications of wounds, as deep-seated abscess, erysipelas, phagedæna, or pyæmia. When the fever does not subside at the ordinary time the presence of some concealed source of irritation, such as lodged foreign body or obstructed discharge, is probable, and should be carefully sought for.

We shall consider this subject of traumatic fever more fully in its surgical bearings presently.

Causes of inflammation.

It is hardly possible to classify, with any regard to practical utility, the causes of inflammation, extending as they do over the whole range of medicine and surgery. The most practical way of regarding the question seems to be that adopted by Sir J. Paget, viz. to classify them as—1. External injuries, viz. contusions, wounds, heat, cold, chemical injuries, and such-like (in these it seems impossible to say through which of the tissues of the part the lesion produces its effect, or whether the whole of the tissues and the contained blood are not equally affected). 2. Causes acting through the nerves, such as the reflex irritation which produces conjunctivitis in one eye as the effect of over-working the other at the microscope (Paget), or the inflammation so often seen in the neighbourhood of the trochanter leading to gangrene of parts in no way exposed to pressure, which is a constant accompaniment of acute disease of the nervous centres. It is true that in this instance there must be considerable vaso-motor disturbances, but C. Bernard's experiments seem to show that such disturbances cannot of themselves originate inflammation. 3. Causes acting primarily through the blood-vessels. To this category are referred certain inflammatory processes which follow on obstruction of the blood-vessels. Sir J. Paget instances the phenomena of bronchitis which sometimes accompany an obstruction, apparently uncomplicated, in the left side of the heart. He allows, however, that it is very doubtful whether the true inflammatory process can be developed by mere changes in the blood-vessels alone. 4. No such doubt can be felt as to the development of inflammation from causes acting through the blood only, since no intelligible or rational explanation can be given of the production of some of the most widespread and most fatal inflammations, such as those of the specific fevers or small-pox, than that they are produced by some fermentative change in the blood.[1] 5. Lastly, that inflammation may have its origin

[1] Many of these widely-spreading inflammations, and notably all those of the erysipelatous type, are now believed by many pathologists to be caused by a 'contagium vivum,' or by bacteria. The evidence up to the present time appears to me to be inconclusive, though it is in the highest degree probable that the theory is true for some of the specific diseases, and it is believed to be proved for anthrax or malignant pustule.

in the extra-vascular tissues is proved by its occurrence in structures such as cartilage or cornea, where there are no blood-vessels or nerves.

It must be remembered, as probably the most important consideration connected with this part of the subject, that all the causes of inflammation tend to a reduction of the actions of the parts, that they are steps towards local death, not, as the ancients believed, an excess of local vigour.

Pathology of inflammation.

The above is intended for a rough sketch of the leading symptoms of inflammation as seen in practice. The pathology or essential nature of the process must next be briefly discussed. It has long been a controversy whether the phenomena which we term inflammation are due to changes in the nervous system, the vessels, the blood, or the tissues; nor is the question one which seems to admit of any confident answer. But the first changes which are perceptible to the eye affect the vessels and their contents at once. The arteries dilate;[1] the blood-stream moves with greater rapidity; the red and white blood-corpuscles, which in the natural state are quite separate from each other as well as from the wall of the vessel, begin to adhere together and to stick to the arterial wall. As the dilatation extends first to the capillaries and then to the veins, the blood-stream moves more and more slowly, the vessels becoming more obstructed by blood-globules. Next, a very remarkable phenomenon is noticed, i.e. the 'emigration' of the white corpuscles, or 'leucocytes,' as they are now usually called. The experiment by which this emigration may be actually rendered visible is very difficult to carry out successfully.[2] It leaves no doubt that the white corpuscles begin to adhere to the wall of the vessel before the axial current (i.e. the current of red blood-globules along the centre of the vessel) stops; that the wall of the vessel then exhibits buds or projections as if the leucocyte were pushing its way through; that these buds or projections become connected with the wall of the vessel by a sort of tongue or string, which then gives way, and leaves a body exactly similar to a leucocyte in the parenchyma external to the vessel; and that the wall of the vessel shows no alteration at the part where the leucocyte has thus passed through it. In what precise manner this may take place it is needless here to discuss. We may suppose, even if only for the sake of hypothesis and to render the thing conceivable, that the leucocyte, which is a mass of protoplasm, rebuilds the wall of the vessel that it is perforating (which is also a mass of protoplasm) as fast as it destroys it.[3] The leucocytes display the same amœboid movements after their emigration

Emigration of leucocytes.

[1] It seems doubtful whether or no this dilatation is preceded by a period of active contraction or spasm of the vessel. If it be so, that period is so transient that it has not been found possible as yet to affirm its constant occurrence.

[2] This experiment was probably first performed by Dr. Waller, before 1846; but his observations did not attract the attention they deserved. Cohnheim devised a more perfect form of the experiment, on a frog paralysed by curare. It will be found very clearly described by Dr. Sanderson, in Holmes's 'System of Surgery,' vol. i. p. 68, 3rd ed. Dr. Sanderson's essay contains also some experiments on the mesentery of warm-blooded animals, which prove that the same process of emigration goes on (and even more abundantly) from the minute veins in mammalia (op. cit. p. 70). At vol. v. pp. 741–2 of the second edition of the 'System of Surgery' will be found an account of the researches and teaching of our distinguished countrymen, Dr. C. J. B. Williams and Dr. Addison, who so nearly anticipated Cohnheim's discovery, in spite of the imperfection of the instruments with which at that time they were obliged to work.

[3] Some authors teach that there are openings or 'stomata' in the capillary wall, through which the corpuscles pass. If this is the case the corpuscles must 'emigrate' also in the healthy processes of nutrition.

which they are known to do within the vessels, and which seem to be connected with their further development. (See Fig. 1.) A too powerful stimulant will stop these amœboid movements both without and within the vessels (Sanderson, op. cit. p. 78).

So far the changes observed refer wholly to the vessels and their contents. But that the tissues around the vessels have an independent and most important part in the process cannot be doubted. Professor Lister [1] has observed changes going on in the pigment-cells lying in the intervascular spaces of the frog's web which testify to an action entirely independent of that in the blood or the vessels; and the action of irritants on the non-vascular tissues, such as the cartilages, will be found illustrated in subsequent pages. Again, as the blood-stream becomes retarded, the blood begins to oscillate backwards and forwards in the vessels, and finally stops. This inflammatory stasis can be produced even when the vessels have been entirely emptied of blood and filled with milk in place of blood. It cannot, therefore, entirely depend upon, though it must doubtless be influenced by, the qualities of the blood. Nor can we imagine that the mere vascular wall can be the sole cause of so remarkable a phenomenon. It must, therefore, be caused in some measure by the vital actions which are going on in the part generally. And the same conclusion results from many of the other recorded facts, for which I must refer to works of

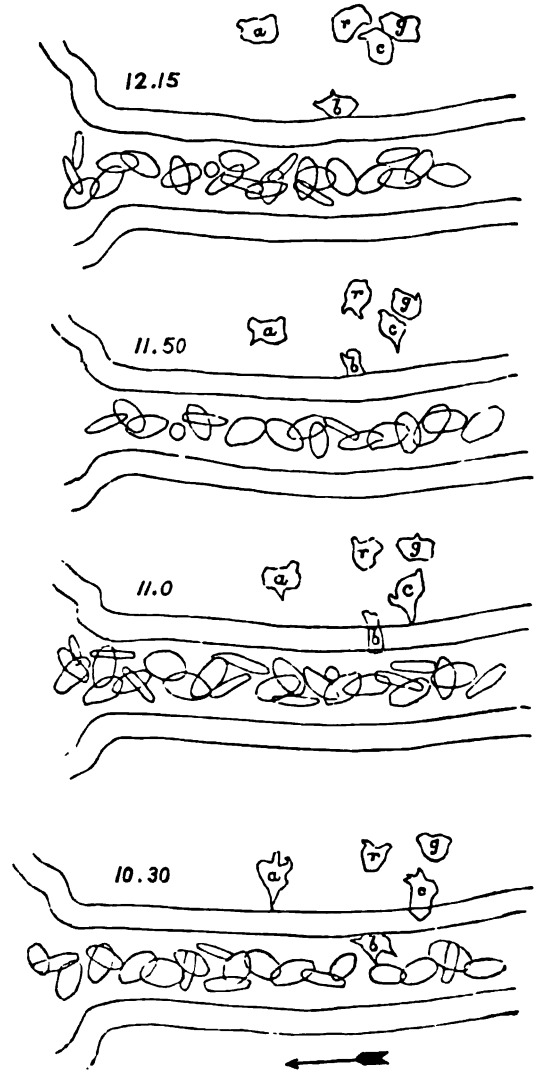


FIG. 1. Cohnheim's experiment showing the emigration of the leucocytes out of a vein in the mesentery of a frog. The times of the successive observations are marked on each figure, and the individual leucocytes are distinguished by different letters. *r* and *g* denote two leucocytes which were external to the vein at the commencement of the observation. *a* was only just attached to the outside of the wall of the vein at the commencement, and was free from it at the second observation. *c* had almost passed through the wall at the first observation, was only just attached at the second, and was free at the third. *b* had commenced to adhere to the interior of the wall of the vein at the first observation, had partially penetrated it at the second, was adhering to its outer wall at the third, and was becoming pedunculated and preparing to detach itself at the fourth. From an experiment made for me by my friend and pupil, the late Mr. J. R. W. Webb.

[1] 'Phil. Trans.,' 1858, p. 678.

more detail. The latest researches seem to show that irritants which do not affect the walls of the vessels, though they may cause dilatation of the capillaries and stagnation of the blood-current, are not followed by emigration of leucocytes, or by transudation of the coloured blood-discs; while if an irritant be applied which acts so deeply and so continuously as to affect the wall of the vessel itself, an abundant emigration of colourless and coloured blood-discs ensues—the former passing chiefly out of the veins and the latter from the capillaries.[1] The question therefore above alluded to would be answered by saying that the essential phenomena of inflammation depend on changes in all the structures—the blood, the blood-vessels, and the parenchyma of the part simultaneously.

Share of micro-organisms in the production of secondary or infective inflammation.

Another question which has latterly attracted immense attention is the part which is played in the causation of inflammation by the minute organisms (bacteria, coccobacteria, or micrococci) which it is now admitted are to be found in every product of acute destructive inflammation. There are several theories on this head; but as yet the subject has hardly passed out of the stage of speculation; so that I must pass it over as lightly as possible, referring the reader for fuller details to Dr. Sanderson's essay 'On the Pathology of Inflammation' in the third edition of the 'System of Surgery,' and to the authorities there cited. These minute organisms are of various shapes and appearances. There are first the ordinary rod-shape particles—bacteria; next the spheroid and dumb-bell particles, more properly called coccobacteria or micrococci; and, finally, certain cloudlike masses, which seem to be leucocytes undergoing degeneration or changing into micrococci.[2] It seems to result from recent investigations that no suppuration and no suppurative exudation is free from the presence of one or other of these forms of organic life, but that the presence of the bacteria proper need not imply anything in the nature of infective inflammation, i.e. inflammation which infects the blood, and will spread either to contiguous parts or to distant organs. Such infective inflammations always imply the presence of micrococci. But the causative connection of the organisms with the inflammation or with its infective property is the point still in dispute. Those who maintain the atmospheric germ theory believe that these particles are deposited from the air on a wounded surface, or are absorbed by the mucous membrane, and so pass into the blood. There are many difficulties, however, in the way of accepting this theory—for instance, that the access of unfiltered air or fluid to the peritonæum has been found incapable of originating any such inflammation; and still more that infective inflammations of the severest type, and characterised by the presence of abundance of micrococci, occur where no atmospheric contamination is possible, as in acute periosteal abscess, and in ulcerative endocarditis. Dr. Sanderson inclines to the belief (which we may accept as the most probable in the present state of our knowledge) that the germs of these organisms exist in the normal fluids or tissues, and are excited to activity and made to develop into the fully-formed micro-organisms by some unknown conditions, and that without such organisms no suppurative inflammation is possible. Of course this theory, if we admit its truth, though it extends our acquaintance with the mechanism of the process, leaves our knowledge of its causation where it was.

[1] See Dr. Klein's account of Cohnheim's researches in the 'London Med. Record,' Dec. 31, 1873, and Jan. 7, 1874.

[2] All this is well illustrated in the plates to Koch's treatise on 'Traumatic Infective Diseases,' translated for the New Syd. Soc., and in Dr. Ogston's Report upon Micro-organisms in Surgical Diseases. 'Brit. Med. Journ.' March 12, 1881.

However these organisms originate, whether implanted from without or developed within the body, they seem to have an intimate relation with the leucocytes. Koch, as above noticed, figures leucocytes as breaking up into masses of micrococci. The micrococci are carried, along with or in the leucocytes, by the veins or the lymphatics.

Treatment of inflammation.

The treatment of inflammation is best studied in each individual form of it. The old idea is now given up, that inflammation is an excess of vital action which must be combated by reducing the powers of life, i.e. by bleeding, purging, and starving, the main elements of what was called the 'antiphlogistic regimen.' Surgeons, and still more physicians, have had only too good reasons to recognise the fact that this treatment is the more fatal the more dangerous and deadly the inflammation itself is, that many of the worst forms of fevers and many of the most formidable results of injury require for their successful treatment not depletion, but support and stimulation. It is quite possible that in the reaction from the errors of a former time we have carried the regimen of support and stimulus to an excess. And it is easy in practice to forget what is so obvious in theory, that the support afforded by tonic medicines, food, and stimulants depends not on the quantity given, but on that which is assimilated. In grave constitutional conditions of fever dependent on or associated with local inflammations, the condition of all the various functions must be carefully considered, and the supply of stimulants, food, and tonics, or the use of depletion, starving, and bleeding, regulated accordingly; nor do I see how I can expend space to any advantage in trying to put down on paper rules for that which can only be acquired by observation and experience. As to the local treatment of inflammation, it may be stated in general terms that it aims at the following indications chiefly:—1. To reduce vascular action or diminish active congestion by cold, evaporation, or pressure. 2. To relieve passive congestion and stasis by heat, by providing drainage from the wound, or by incision in appropriate circumstances. 3. To let out the products of inflammation by incision, or to remove from the inflamed surface the putrefying or putrefiable materials which may infect the mass of the blood; and lastly, to surround the inflamed part with the healthiest atmosphere possible, and with all other local conditions which in the judgment of the surgeon will most effectually prevent or modify putrefaction.

But I am aware that such general statements as these are of little practical value, and the reader will get a much better idea of the treatment of inflamed parts by studying the numerous examples of it to be found in subsequent pages.

Terminations of the inflammatory process.

The process of inflammation may be regarded as destructive or constructive, according to its terminations. If the process above described should cease at the point to which the description has just been carried, the blood-stream will resume its movement, the vessels their normal size, the effused serum and the leucocytes will disappear from the intervascular spaces, and the part will resume in all respects the functions and appearance of health. This termination is known in surgical language as 'Resolution.' But if this does not occur, the inflammatory exudation may become organised into new tissue (organisation, adhesion), or it may break down into pus (suppuration, abscess), or the tissue of the part may become softened and disintegrated (ulceration), or the whole part may die (gangrene).

Resolution.

Effusion and organisation.

The production of new tissue may be regarded as the curative termination of inflammation. It is true that in many instances this newly-formed tissue impairs the functions of the part and constitutes in itself a kind of disease.

Thus the utility of joints is destroyed by soft ankylosis, the result of inflammatory adhesions; or bands of adhesion are formed in the peritoneum which may fatally interfere with the movements of the intestines. But it is none the less true also that it is upon such reproductive properties that all the repair of wounds and fractures depends, and that the greater part of the practice of surgery is directed to the production and regulation of this reproductive process.

It will be most convenient, I think, to study here this curative termination of inflammation as it is seen in the soft parts; while the chapter on the union of fractures will contain a description of inflammatory organisation in the hard tissues. I therefore turn to the general subject of wounds and the process of their union, in order to illustrate the results of inflammation.

Wounds and contusions.

A forcible solution of continuity in the soft tissues of the body is called a wound; but, in ordinary language, the exposure of the injured part to the air is implied, and the action of some weapon is also understood. When the subcutaneous tissues are merely bruised, i.e. more or less lacerated without the skin being divided, the injury is called a 'Contusion.' In a contusion there is probably always some laceration of the fibres of the cellular tissue, the vessels are more or less ruptured, and blood is extravasated proportionally into the subcutaneous or parenchymatous tissue, or into any of the neighbouring cavities of the body. In very severe contusions, such as are produced by repeated injuries, the skin is very extensively separated from the subjacent fascia,[1] and is consequently liable to perish for want of blood-supply. Into this space blood is effused, which, showing through the skin, gives the familiar black-and-blue appearance of a bruise, the colour varying with the delicacy of the skin, the quantity of blood effused, and the structure of the part. Thus, in the eyelids, scrotum, and vulva a bruise is black; on the scalp, where the skin is strengthened by the tendon of the occipito-frontalis, it shows hardly any colour at all; on the globe of the eye, where the conjunctiva allows the free passage of the air, it is scarlet. The black colour of an ordinary bruise on the surface of the body fades away into green or yellow as the blood is absorbed. Very frequently, when the laceration has been great, the blood remains for an indefinite time collected in a cavity, the walls of which are formed of blood-clot and condensed tissues, while its contents consist of serum mixed with more or less of the colouring matter and broken-down corpuscles.

Hæmatoma.

To such a collection the name Hæmatoma, or 'blood-tumour,' is given. Blood-tumours are distinguished from abscess by the history, appearing as they do at once after the contusion; by the thinner character of the fluid, contained in a wall of solidified, but not inflamed, tissues; and by the uninflamed and unengorged condition of the integuments. They are comparatively common on the scalp in infancy and childhood, sometimes extending over half or the whole head. They usually subside spontaneously, even when of very large size, though their absorption is generally considered to be accelerated by some of the stimulating lotions or embrocations usually ordered, among which arnica is perhaps the most in favour.[2] But such stimulating applications should not be made use of immediately after the injury. The applica-

[1] In examining the body of a schoolboy who had been beaten to death by his schoolmaster, Mr. Prescott Hewett and I found the skin so extensively separated from the fascia lata that a common walking-stick could easily be laid between.

[2] The applications in common use in cases of contusion are:—Tincture of arnica, gently rubbed in, either pure or diluted with its own bulk of water, or as a lotion with five to ten parts of water; or poultices of black briony-root (much valued by pugilists); or Friar's balsam, or soap and opium liniment.

tion of cold is indicated at first, so long as it seems probable that fresh blood is being effused; unless the skin is so extensively separated that gangrene is to be feared, in which case moderate warmth (as by water-dressing or warm opiate lotion) is more advisable. In some cases, when the effused blood shows no tendency to disappear, it has been removed by puncture with impunity; but as this is usually unnecessary, it should not be done except in the last resort, and then the 'aspirator' of Dieulafoy, or some such invention for avoiding the entrance of air, should be employed. If the tissue around inflames, forming pus, the bloody fluid becomes decomposed and a serious form of fever may be generated. In such a case, as in that of inflammation of the sac of an abscess, it becomes necessary to lay open the cavity freely, wash it out with carbolic lotion daily, and support the patient's strength through the ensuing fever. Thus we see that, as a rule, contusions do not require any inflammatory process for their cure; and that when inflammation follows on a contusion it is usually as a complication, and one which, when it reaches the stage of suppuration, may prove a formidable one. But the hardening which sometimes remains permanently in a contused part is also very probably in many cases the result of chronic inflammation, leading to the formation of a low form of fibrous tissue.

The question as to the organisation of bloodclots is one of much interest, both in a pathological and practical point of view. John Hunter taught unreservedly that coagulated blood 'either forms vessels in itself, or vessels shoot out from the original surface of contact into it, forming an elongation of themselves, as we have reason to suppose they do in granulations;' and in order to define his meaning more precisely he immediately adds, 'I have reason, however, to believe that the coagulum has the power, under ordinary circumstances, to form vessels in and out of itself;' and of this supposition he proceeds to give proofs, for which I must refer the reader to the original.[1] On this supposed property of extravasated blood to take on active processes of organisation in its own substance, independent of the structures amongst which it was lying, depended, amongst many other surgical doctrines and precepts, the treatment so much recommended by Sir A. Cooper, and still occasionally practised, of laying a piece of lint steeped in the blood of the part over the wound of a compound fracture in order that the blood might form a bond of union, and convert the compound into a simple fracture. It seems, however, to say the least, highly dubious whether any such self-organisation of clots is possible. The practical result is doubtless the same, viz. that in the substance of the clot vessels are formed, and ultimately the coagulum is replaced by a membrane or fibrous sac more or less complete, and including in its substance the remains of the blood-corpuscles. But it seems more probable, as Rindfleisch has pointed out,[2] that the efficient agents in this organisation are leucocytes, which are derived, not from the white corpuscles of the clot itself, but by immigration from the neighbouring vessels or tissues. 'Artificial thrombi,' says this author, 'have been produced by tying arteries in the lower animals; cinnabar has then been injected into the blood, and its leucocytes impregnated with this finely granular material, which is easily recognisable under the microscope. It was found that those cells from which, on the second or third day after the occurrence of coagulation, the organising process appeared to set out, contained cinnabar—the inevitable inference being that they had emigrated into the clot from without.' He then describes the branching out and com-

[1] 'On the Blood, Inflammation, and Gunshot Wounds.' Hunter's Works by Palmer, iii. 119.

[2] 'Pathological Histology,' trans. for the New Syd. Soc., vol. i. p. 225.

munication of the leucocytes to form 'a delicate protoplasmic network with nuclei in its nodal points,' through which capillary channels are afterwards opened out, these channels ultimately anastomosing with the vasa vasorum; while in the interspaces a connective tissue is formed from the fibrine of the clot, involving in its meshes the remains of the blood-corpuscles, which at first entirely obscure it; and then, as the clot shrinks and hardens, they wither away, lose their colouring matter, and there remains instead of every red corpuscle a flake of colourless protoplasm.

All this applies to the organisation of non-laminated thrombi contained within the vessels. Of the minute phenomena of organisation in extravascular and laminated coagula nothing is known. More will be found, on the changes which intravascular thrombi undergo, in the chapters treating of the diseases of the ARTERIES AND VEINS.

Treatment of contusions.

The treatment which is to be selected in any case of contusion depends on the severity of the injury. When the blow (as is often the case) entails much loss of power and pain in attempted movement, it is obvious that rest is the main requisite. Warmth should be applied, as by a piece of heated spongiopiline, or warm lotion, covered with oiled silk. In smaller and less disabling injuries some active movement is desirable, and gentle rubbing will relieve the pain and promote absorption of the effused blood.

Wounds.

Wounds are divided for purposes of description into *incised*, i.e. simple cuts in which the length bears a considerable proportion to the depth; *punctured*, in which the depth much exceeds the length, the latter being more of the nature of a prick than a cut; *subcutaneous*, in which a considerable extent of tissue (generally including one or more large tendons or muscles) is divided through a mere puncture of the skin[1]; *contused*, in which the divided tissues and those around are contused as well as cut; and *lacerated*, in which the whole or a portion of the solution of continuity is caused by tearing and not by cutting.

The incised are the most common, and those from which the process of union is best studied.

The processes by which wounds are united illustrate very aptly the various events of inflammation regarded both in its curative and in its destructive aspect.

Immediate union or 'primary adhesion.'

1. When the surfaces of a clean-cut wound, such as that made in the operation for harelip, are carefully adapted to each other, and supported for a sufficient length of time in apposition, they will probably be found to present no sign of inflammation appreciable by the senses, and in the course of from twenty-four to forty-eight hours the wound will be so soundly united as to require no further attention, nothing being left except a linear mark, which at first looks more or less red, but gradually fades away, and in the case of small cuts disappears altogether. This method of union is called *immediate union* or *primary adhesion*. In this form there is little or no evidence of inflammatory effusion, and some pathologists have taught that the tissues merely adhere and grow together. This, however, is hardly an intelligible account of the action of living tissues, and it seems more probable that the process differs in no respect from that to be next described, except that the symptoms are less obvious.[2]

[1] As known in practice subcutaneous wounds are made in surgical operations, and they are obviously a kind of punctured wounds.

[2] I would beg the reader to remember that inflammation (as stated above, footnote p. 2) is not separated from the normal processes of growth and repair by any essential difference

Union by first intention.

2. The next process is that of *union by first intention or primary union.* In this the cut surfaces pour out a certain quantity of blood which, if in small quantity, is probably entirely absorbed, although it is a very common opinion that a portion of it becomes organised, i.e. that the leucocytes become developed into permanent tissue in the extravasated blood, as they do in the inflammatory effusion. In the latter the process of development goes on by the amœboid leucocytes attracting to themselves and absorbing into their tissue the pabulum appropriate for their nutrition from the neighbouring plasma. Thus masses of protoplasm are formed, around which a cellwall is developed. The nuclei of these cells divide and multiply to form new cells, or 'proliferate,' as it is called. The rounded cells then elongate into fibre-cells, out of which are formed the fibrous elements of the connective and vascular tissues; the neighbouring vessels shoot out processes into the growing tissue, the unused serum, &c., is re-absorbed, and thus the wound is closed by new material, with no formation of pus.

For the minute details of this process I must refer the reader to the works which treat specially of pathology. It will be sufficient here to say that as far as is known at present both the vessels and the connective tissue are formed out of leucocytes, and that the latter may be furnished either by emigration out of the vessels, or from the connective tissue of the part, or, as some pathologists now teach, by proliferation of the endothelium; that some of these leucocytes are converted into cells which, communicating with each other, form vascular channels, while others are elongated into spindle-shaped cells, the rudiment of fibres; and that the vessels are formed in one of two ways, either by channels (as above) formed out of leucocytes and afterwards opening into the capillary tube, and receiving a layer of endothelium from it, or by a budding out of the endothelial tube of the capillary, which bud elongates into a loop and opens into another part of the capillary tube. The former is called by Billroth *secondary* and the latter *tertiary* vascularisation, in contradistinction to the *primary* vascularisation seen in the embryo, in which the vessels are directly formed by the differentiation of previously indifferent cells, others of which are developed into blood-corpuscles.[1]

Lymphatic vessels are observed in the cicatrix after the formation of the fibres of which it is composed, and nerves are also probably produced in it.

of kind, but merely by one of degree. The less the processes of union differ from those of health, the more perfect and the more secure are they. They are, in my opinion, still processes of inflammation, and not processes of healthy growth. Billroth speaks to the same effect, if I understand the passage as translated in the New Syd. Soc.'s Transl., vol. i. p. 107. Others seem to teach the reverse, but I confess that I have failed to understand their doctrine. The question is more speculative than practical.

[1] In a passage of his most recently translated edition (New Syd. Soc.'s Transl., vol. i. pp. 88–90) Billroth seems inclined to give up the *secondary* vascularisation altogether, and to refer all formation of new vessels to a process of budding from the original capillaries. The same doctrine is taught still more unreservedly by a recent writer, Mr. Hamilton, Pathologist to the Edinburgh Infirmary, in an interesting paper in the 'Journal of Anatomy and Phys.,' July, 1879. According to him the new vessels are merely projections from the old ones; the new fibrous tissue is formed, not from blood-leucocytes, but from the connective-tissue corpuscles of the old fibrous tissue. Granulations are not media for healing in any degree, but mere obstacles to the healing process. I must refer the reader to the original paper, which is interesting, but to me not very convincing; the theory that the vessels of granulations are mere mechanical projections from the underlying capillaries—hernie (as it were), the result of the liberation of those vessels from the pressure of the superjacent integument—being especially hard to believe. But in one great and essential particular I quite agree with the author—viz. that all the various forms of the inflammatory process are identical in essence, as, in fact, I have stated in the text, page 15.

Muscular tissue is never reproduced, but the interspace caused in a muscle by a wound is filled up with fibrous tissue; at least, this seems to be the case in man. In animals, according to some observers, muscular fibres may be to some extent reproduced (Billroth, New Syd. Soc.'s Trans., vol. i. p. 150).

Suppuration. Union by second intention.

3. If the inflammation passes this point, then we have the phenomena of *suppuration*, one of the destructive terminations of the inflammatory action, and the method of union is that which is known by the technical name of *union by the second intention*. The inflammatory leucocytes, instead of developing into fibre-cells and forming tissue, become developed into *pus-globules*, and the exudation breaks down more or less completely into a creamy fluid called *pus*, which consists of these globules floating in serum, the *liquor puris*. Pus-globules, as seen out of the body, are but little different in appearance from leucocytes. The leucocyte when treated with acetic acid displays the appearance of a nucleus in its interior, that appearance being usually regarded as the result of a shrinking of the protoplasm of which it is composed. The pus-globule shows more distinct trace of a membrane, and is frequently many-nucleated when treated with acid, a condition which Rindfleisch regards as indicating a tendency to degenerate and break down. But the same author says that many of the corpuscles of pus display no difference whatever in character from the blood-leucocytes, having only single nuclei, showing the same amœboid movements, and being in fact obviously the same things, both in structure and function. This should be borne in mind in connection with the fact that suppuration is not in most cases wholly a destructive process, but serves also as one of the usual modes of repair.



FIG. 2. Pus-corpuscles. *a*. From a healthy granulating wound. *b*. From an abscess in the areolar tissue. *c*. The same treated with dilute acetic acid. *d*. From a sinus in bone (necrosis). *e*. Migratory pus-corpuscles.—From Rindfleisch's 'Pathological Histology.'

The result then of the process of suppuration is twofold. The greater part of the pus is sooner or later cast out of the body. When the suppuration is in the interior of the body this is effected usually by the formation of an *abscess*; the pus-globules make their way to a common centre, and the matter becomes enclosed in a cyst or cavity formed by inflamed tissue. As the inflammation progresses the tissues soften and break down in some definite direction, usually towards the surface of the skin or one of the cavities of the body, and the pus shows through the thin tissue which is raised up by the fluid underneath it, allowing perhaps even the colour of the pus to be distinguished. Then the abscess is said to *point*, and will shortly burst, if not opened by the surgeon. In some cases, however, no such collection of the pus takes place, the matter is diffused with no definite limit through the interstices of the part—*diffuse inflammation*. When suppuration occurs on the internal surface of one of the cavities of the body, as in purulent inflammation of a synovial membrane, it forms what is often spoken of as *abscess* of the cavity, although the matter is really contained, not in a cyst formed by the inflamed tissues, but in the natural bag of the serous or synovial membrane, which in some cases may be free from inflammation at the part where the pus is found.

Inflammatory softening. Ulceration.

As the tissues inflame, and as the leucocytes multiply, the normal cells of the part *proliferate*, that is to say, they give rise to fresh cells by the multiplication of their nuclei, while they themselves become indistinguishable. Coincidently with this the fibres of which the part is composed soften, and in many

tion of cold is indicated at first, so long as it seems probable that fresh blood is being effused; unless the skin is so extensively separated that gangrene is to be feared, in which case moderate warmth (as by water-dressing or warm opiate lotion) is more advisable. In some cases, when the effused blood shows no tendency to disappear, it has been removed by puncture with impunity; but as this is usually unnecessary, it should not be done except in the last resort, and then the 'aspirator' of Dieulafoy, or some such invention for avoiding the entrance of air, should be employed. If the tissue around inflames, forming pus, the bloody fluid becomes decomposed and a serious form of fever may be generated. In such a case, as in that of inflammation of the sac of an abscess, it becomes necessary to lay open the cavity freely, wash it out with carbolic lotion daily, and support the patient's strength through the ensuing fever. Thus we see that, as a rule, contusions do not require any inflammatory process for their cure; and that when inflammation follows on a contusion it is usually as a complication, and one which, when it reaches the stage of suppuration, may prove a formidable one. But the hardening which sometimes remains permanently in a contused part is also very probably in many cases the result of chronic inflammation, leading to the formation of a low form of fibrous tissue.

The question as to the organisation of bloodclots is one of much interest, both in a pathological and practical point of view. John Hunter taught unreservedly that coagulated blood 'either forms vessels in itself, or vessels shoot out from the original surface of contact into it, forming an elongation of themselves, as we have reason to suppose they do in granulations;' and in order to define his meaning more precisely he immediately adds, 'I have reason, however, to believe that the coagulum has the power, under ordinary circumstances, to form vessels in and out of itself;' and of this supposition he proceeds to give proofs, for which I must refer the reader to the original.[1] On this supposed property of extravasated blood to take on active processes of organisation in its own substance, independent of the structures amongst which it was lying, depended, amongst many other surgical doctrines and precepts, the treatment so much recommended by Sir A. Cooper, and still occasionally practised, of laying a piece of lint steeped in the blood of the part over the wound of a compound fracture in order that the blood might form a bond of union, and convert the compound into a simple fracture. It seems, however, to say the least, highly dubious whether any such self-organisation of clots is possible. The practical result is doubtless the same, viz. that in the substance of the clot vessels are formed, and ultimately the coagulum is replaced by a membrane or fibrous sac more or less complete, and including in its substance the remains of the blood-corpuscles. But it seems more probable, as Rindfleisch has pointed out,[2] that the efficient agents in this organisation are leucocytes, which are derived, not from the white corpuscles of the clot itself, but by immigration from the neighbouring vessels or tissues. 'Artificial thrombi,' says this author, 'have been produced by tying arteries in the lower animals; cinnabar has then been injected into the blood, and its leucocytes impregnated with this finely granular material, which is easily recognisable under the microscope. It was found that those cells from which, on the second or third day after the occurrence of coagulation, the organising process appeared to set out, contained cinnabar—the inevitable inference being that they had emigrated into the clot from without.' He then describes the branching out and com-

[1] 'On the Blood, Inflammation, and Gunshot Wounds.' Hunter's Works by Palmer, iii. 119.

[2] 'Pathological Histology,' trans. for the New Syd. Soc., vol. i. p. 225.

ally be seen to be developed into epithelium. The cavity of the wound is closed by the constant organisation of the deep parts of these granulations, as the superficial parts melt away into pus, and ultimately by the formation of epithelium over their surface—'skinning over,' as it is popularly called.

Cicatrisation.

The cuticle is formed mainly by the differentiation of the outermost cells of the granulating surface; but it seems probable that the proximity of the natural epithelium of the edge of the ulcer or wound has, to say the least, a considerable effect in producing or disposing to the production of this new epithelium. For though in an ulcer new formations of epithelium may often be seen far away from the edges, yet the skinning over far more commonly spreads from the edge, i.e. from the old epidermis; and the phenomena of skin-grafting also show how much the production of epidermis is hastened by applying a healthy epidermal tissue on healthy granulations.

The formation, then, of the cicatrix in union by second intention differs very widely in its external phenomena from that which is seen in union by first intention, and all the differences are in favour of the latter process. In the suppurative union there is greatly more destruction of tissue, much more time is required, all the symptoms affecting the patient's health are far more severe; and the newly-formed bond of union is more lowly organised, more prone to various degenerations, and more inadequate to replace the tissue in whose place it has been deposited. Yet, as will be seen from the above sketch the essence of both processes is the same. Both depend on the organisation of leucocytes into cellular tissue, and the development of new vessels; and the essential features, both of vascularisation and of organisation, are similar, only that in the secondary union many of the leucocytes lie too far from the vessels to obtain the nourishment which is necessary for their growth, and therefore break down into pus.

Union by 'secondary adhesion,' or by 'the third intention.'

4. Besides the common process of repair by suppuration, i.e. union by granulation, or by second intention, there are two other processes described by Paget analogous to and in fact to a great extent identical with it essentially, but differing in some important practical details; they are union by *secondary adhesion*, or by the *third intention*, and union *under a scab*. The former process is best illustrated by the wound of an operation for harelip in which the attempt to obtain primary union has failed, and the surfaces of the wound have begun to granulate. If the ordinary process of union by second intention were allowed to go on to its termination, these granulations would gradually fill the wound up until the whole cavity was closed more or less imperfectly by a dense cicatrix; or, as would most likely be the case in the instance supposed, the two surfaces of the lip would scar over, and the cavity would not be filled at all. But sometimes, when the granulations are perfectly healthy, if the surfaces be brought evenly together throughout, they will adhere without any further suppuration, the growing tissue at the base of one set of granulations coalescing with that at the base of those on the opposite side, and thus the wound will be closed perfectly and at once.

The advantages of this process are that it leaves much less scar behind; that the scar is much more nearly equal in size to the cavity which it fills, and that it is completed in a very short space of time, so that any bone or other important part which has been exposed in the wound gets rapidly covered over and defended from the inflammatory action. The two former points are of interest in wounds of the face or other exposed part; the last is of great importance in scalp wounds, where exposed bone can often be rapidly covered by bringing the granulating edges (if perfectly healthy) into contact

by means of one or two silver sutures, and thus all risk of necrosis, or inflammation of the exposed cranium, will be avoided.

Union under a scab.

5. Union under a scab, or union by scabbing, takes place either in fresh wounds or in those which have been previously granulating. In fresh wounds the surface is covered by a layer of dried blood, or of the inspissated secretion (serum and lymph), which will ooze from the divided vessels just after the bleeding has ceased; and when this comes away the surface is found to be skinned over. The exact nature of this process does not seem to be altogether understood. It is constant in animals, but very rare in man, though Sir J. Paget relates two instances in which even so large a surface as that left after removal of the breast has been thus healed.

In the case of a granulating wound the surface of the granulations is coated over either naturally with inspissated secretion (pus and serum), or artificially with some semi-fluid substance which excludes the air; the superficial portion of the granulations is then at once converted into epithelium, and the cicatrisation is completed without further suppuration. When the scab falls off a scar is found below it.

Cicatrices.

The material by which a wound is united is called a cicatrix. It differs from the normal tissue which it has replaced in many important particulars. As Rindfleisch says: 'The cicatricial tissue is far from being a connective tissue of ideally high quality. On the contrary, its fibres are stiff, inelastic, and misshapen; its cells are represented by shrunken, staff-shaped nuclei, and its vital capacity is proportionally reduced. Moreover, the cicatricial tissue exhibits an extreme proneness to contract in all its dimensions. . . . It need hardly be said that this general diminution in bulk is a physical rather than a vital phenomenon. The removal of water has a great deal to do with it, for the white glistening tissue of a cicatrix is dry, compact, and harder to cut than any other variety of connective tissue.' These remarks of Rindfleisch are applied by him to the cicatrix produced by primary union; but they apply still more forcibly to that of the union by second intention; and generally it may be said that the longer a cicatrix is in forming, the more imperfect will be its organisation, the more will it be likely to fall short in bulk of the parts which it replaces, and the more liable will it be to all the various diseases which affect scars, such as contraction, ulceration, cheloid and cancerous degeneration. All these diseases will be found treated in the chapter on ULCERS.

Traumatic fever.

We have spoken incidentally of traumatic fever as one of the occasional phenomena of inflammation, but this subject is so important in practical surgery that it demands a very careful study. The inflammatory process involves, as we have seen (p. 2), as one of its necessary results, the generation of heat in the blood of the inflamed part. When that part is small and insignificant the slight additional heat thus imparted to the total mass of the blood is easily got rid of by the natural processes of transpiration through the skin and lungs. But if the inflammation is very extensive the bodily powers may not be sufficient to dispose of the excess of heat—the wdole mass of blood then rises in temperature, and the phenomena of fever result. This is the simplest theory which can be formed of the causation of fever, and that it is true in part, I think, can be hardly doubted, though it is far too simple to be accepted as a solution of all the complicated facts of inflammatory fever. Besides this mere increase of heat from simple inflammation, it seems necessary to admit that the blood is also poisoned by the imbibition of some product of inflammation; and hence the intimate, not to

say indissoluble, connection between traumatic fever and that constitutional infection now commonly called septicæmia.

That traumatic fever may originate independently of absorption of any of the products of decomposition, or even of inflammation, is proved by the fact that it arises occasionally almost immediately after the injury, and nearly as soon as the inflammation itself does. Since, in these cases, there has been no time for the imbibition of decomposing matters into the blood, there are, as far as I can see, only two hypotheses by which the occurrence of fever can be explained, viz. either the simple one of increase in the heat of the blood, or the supposition (which is only slightly different) that such overheated blood, circulating through the nervous centres, disturbs the chief functions of respiration, circulation, &c. But since, commonly speaking, fever does not set in till a period at which the products of inflammation have formed and have had time to decompose or ferment;[1] since similar phenomena may doubtless be excited, in a previously healthy animal, by the injection into the circulating blood of various putrefying matters; and since the gravity of the traumatic fever seems often to bear a proportion to the amount of decomposition present in the wound, it appears, to say the least, probable in the highest degree that the efficient cause of the fever is in most cases, though not in all, the imbibition of some of the products of inflammation into the blood. On this point Billroth speaks as follows:—

'Owing to the very nature of the process, the tissues at the seat of inflammation undergo extensive chemical changes: it is probable, therefore, that some of the products of these changes find their way into the blood, either through the blood-vessels or lymphatics. Such products may easily give rise to organic decomposition in the blood, as the result of which throughout the entire blood-mass an increase in the heat-production would result. We might even admit a more complicated theory of heat-production through the interposition of the nervous system, and one which in many respects would be more applicable, namely, that the blood, altered by the absorption of inflammatory products, reacts on the vaso-motor centres in such a way that a disturbance in the regulation of the heat-supply is produced, and in consequence a rise in the temperature takes place. The choice between these different hypotheses is difficult: each one at present has a show of probability. The latter theories have this in common, that a contamination of the blood by products from the diseased or injured part is taken for granted, and that they exercise a certain influence on the heat-production—are, in other words, fever-producing materials (pyrogens). This has to be proved. It has been shown by the experiments of O. Weber, myself, and others, that in most open wounds, especially in contused wounds, shreds of connective tissue decompose and die; in many spontaneous inflammations the circulation ceases in some parts of the inflamed tissues—hence decomposition sets in. Decomposing tissue, then, is an object which must be examined as to its power of setting up inflammatory action. If filtered infusions [of this substance] be injected into the blood of animals, they get violent fever, and not infrequently die with symptoms of collapse, somnolency, and simultaneous hæmorrhagic diarrhœa. The same effect is produced by injecting perfectly fresh pus; a less vigorous effect is produced by employing the juices and pus-serum which may be squeezed out

[1] Billroth says that in his numerous observations the fever has usually been found to commence before the end of the second day. Mr. Pick ('St. George's Hospital Reports,' vol. iii.) says that out of 108 cases 'in no single instance did it occur after the fifth day, and in some cases it occurred within the first twenty-four or forty-eight hours.'

then, which tends to make a wound 'do well'—that is, which favours rapid union with the least possible amount of suppuration, and as perfect an immunity from putrefaction as possible—will *pro tanto* diminish the liability to traumatic fever. It is of primary importance, in surgical operations, so to contrive the incisions that the parts may lie in apposition without tension or discomfort, and that the bloody serum and the products of inflammation which will soon exude from the cut surfaces may find a ready exit; or, if this is impossible, to provide an artificial exit for them by means of a drainage-tube, or drains of some unirritating substance, such as horsehair. The position of the patient or of the limb, and all the details of careful and cleanly nursing, are also to be sedulously attended to; and then occurs the important question of how to dress the wound.

Dressing of wounds.

It certainly may seem strange that after, at any rate, more than a century of careful, diligent, and scientific observation, from the days of Hunter to the present time, surgeons are far further from agreement as to what is the best plan for dressing a common incised wound than they probably were in the days of Podalirius and Machaon, when such points were settled by traditional authority. Yet so it is. One distinguished surgeon (Professor Lister) sees in the atmospheric air the universal medium of contagion, and the vehicle by which all the germs of corruption are conveyed to the wound. Another (Dr. Humphry) teaches that wounds do best when freely exposed to the air without any material of dressing whatever. A third (Sir W. Fergusson), after perhaps a more extensive operative experience than that of any other surgical authority of his day, repudiated all special methods of treating wounds, and thought that as a general rule they do better with water-dressing than with any other application. I have no claim to dogmatise on a question on which such eminent surgeons differ; but there is one point of extreme importance on which I think all would be agreed, i.e. that scrupulous care in the dressing of a wound, to see that all the materials used are clean, and that no accidental impurity can afterwards find access to it, will go far to ensure its safe and rapid union. When we get beyond this, and inquire into the value of special plans, we are met by the difficulty that in carefully-managed hospitals (by which I mean not only hospitals where all sanitary details are properly cared for, but also where the surgeons, house-surgeons, and dressers are careful to dress all wounds themselves, and to avoid everything that could even produce any risk of contamination) almost all plans of dressing wounds will succeed so often that it is hard to classify the exceptions for the purpose of comparison, while, under the opposite conditions, all plans will equally fail. Allowing for this I cannot but express my own strong conviction of the value of the method of dressing wounds which Mr. Lister has introduced. I have frequently ascertained by thermometric and other observations, and pointed out to others, the perfect immunity from traumatic fever which in some cases follows even the gravest injuries or operations thus treated;[1] and although I quite admit that a similar immunity follows after other methods of dressing, yet I think it is

Lister's 'antiseptic' method.

[1] An instance which much struck me was the following:—A man was admitted into hospital with a most formidable compound fracture of the leg. I thought it necessary to resect more than two inches of both bones, in order to avoid amputation, and was gently blamed by a senior colleague for not choosing the latter alternative. The wound was dressed according to Lister's method. I asked the house-surgeon to construct for me a thermograph of traumatic fever from this case, wanting it for a lecture. But the most careful morning and evening observations failed to detect the least rise of temperature, nor were there any other symptoms. The wound healed kindly and rapidly, and the man was discharged with a perfectly sound and strong, though shortened limb.

more common after that which is called 'the antiseptic system' than any other,[1] and on that account I advocate the use of that system, as well as on account of its utility in hospital practice; for it necessitates the dressing of important cases by the surgeons or house-surgeons themselves, and almost excludes the possibility of any subsequent inoculation.

Professor Lister's directions for this dressing may be summarised as follows:—The principles of the method are: (1) to destroy any germs of putrefaction which may have been accidentally implanted in the wound before it is dressed, or to guard against any such implantation; (2) never to allow the access of air to the wound except filtered through the antiseptic; and (3) to provide for the drainage of decomposable fluids from the wound without admitting the entrance to it of unfiltered air.

1. In cases which are not seen till some time after the injury the first indication is fulfilled by washing out the wound freely with a lotion of carbolic acid—1 part in 40[2]—and in an operation either by performing the operation in a cloud made by pulverising this lotion in a spray-producer, or by washing the wound out with it freely as soon as the operation is over; and it is a useful additional precaution to wash the part to be operated on, the hands, and the instruments in the same lotion, and to carbolise any oil used for saws or other purposes.

2. The second indication is accomplished by wrapping the wound up in a medium saturated with carbolic acid, and providing that this medium shall extend far enough on all sides of the wound to obviate the access of any air which has not been thoroughly filtered through the disinfectant. The medium now generally used is 'antiseptic gauze'—a light cotton cloth of open texture impregnated with a mixture of carbolic acid, resin, and paraffin, in which the resin serves as a vehicle for the acid, while the paraffin is added to prevent inconvenient adhesiveness.[3] Six or eight layers of this are wrapped about the wound, and these are covered with a light macintosh cloth, which surrounds and overlaps the whole, in order to prevent the discharge from saturating the gauze, and so bringing about a direct communication with the outer air. The macintosh compels the discharge to travel through the whole of the antiseptic atmosphere, and thus insures the disinfection of the air which comes along its track. In other cases it may be more convenient to wrap the part in lint saturated with carbolised oil, supported by the carbolic lac-plaister. In order to avoid the irritating action which the stronger solutions of carbolic acid exert on the raw edges of the wound, it is well to protect them with oiled silk dipped in a weak solution of the acid, or with a peculiar preparation of oiled

[1] The opinion, if true, does not of necessity involve any adhesion to the 'germ-theory' of disease, nor to the doctrines as to the presence of such germs in the atmosphere under ordinary circumstances. As far as I am competent to form an opinion on such matters the opponents of these theoretical doctrines seem to me hitherto to have had the best of the controversy. But however putrefaction is produced, there can be no question that carbolic acid, amongst other substances, stops it. Nor do I think there will be much doubt in the mind of any surgeon who will give a really patient and extensive trial to the use of this and possibly other antiseptic substances as dressings, of the great utility of the plan, especially in hospital wards, where numerous wounds are sometimes collected together.

[2] If the putrefaction has attained a considerable height it is best to sponge the whole surface thoroughly with a lotion of chloride of zinc, 20–40 grains to the ounce of water, as recommended by Mr. Campbell De Morgan.

[3] This gauze is generally supplied ready-made, as is also the antiseptic lac-plaister, the protective oiled silk, and the catgut ligature; but those who are at a distance from the instrument-makers will find all necessary directions in Professor Lister's article in 'System of Surgery,' vol. v. pp. 621 et seq., 2nd ed.

silk termed 'the protective,' which is dipped in the weak lotion 1 : 40. The object is to defend the wound and at the same time to guard against the implantation of fresh germs of putrefaction. In changing the dressings the most convenient plan and the surest is to surround the whole with the carbolised spray. If this is not at hand, a thin rag steeped in carbolic lotion—'antiseptic veil,' as it is called—must be slipped over the wound as the dressings are removed; and if it is necessary to expose, examine, or otherwise manipulate any part, it must be irrigated during the whole time with the same lotion dropped from a syringe. The presence or absence of putrefaction is judged of partly by the odour, partly by the colour of the 'protective,' which turns from a light green to a black by contact with putrefying matters.

3. In all large wounds which are closed at once with a view to rapid union there occurs always a very considerable oozing. This consists partly of blood and partly of inflammatory discharges (serum and lymph).[1] If allowed to accumulate in the cavity of the wound, such fluid mechanically impedes union, and (which is more serious) it will probably putrefy. Drainage of putrefiable matters is therefore secured by insertion into the wound, in any convenient part or parts, of a drainage-tube, or a piece of lint, or skein of horsehair rendered antiseptic by immersion in carbolised oil; but the drain must not project beyond the antiseptic dressing any more than the 'protective' must, otherwise they would serve to conduct the undiluted atmosphere to the wound; and any collections of matter must be opened under the spray or the antiseptic veil, while all putrefying sinuses must be freely injected with the antiseptic lotion.

In this method of dressing the vessels must, of course, be secured with the carbolised catgut, as described in the chapter on Hæmorrhage. Some operators use this gut also for the sutures, others carbolised silk, but I think metal superior, as being perfectly free from any liability to putrefaction, and able to hold for an unlimited time. I often leave the sutures in place for a fortnight or more, while the carbolised gut will become so far melted in four or five days as to break with the weight of the flap. If strapping be wanted in dressing the wound, it should be dipped in a hot solution of carbolic acid, to render it antiseptic before it is applied, or at any rate passed through an atmosphere of carbolic acid.

The chief objection to the carbolised dressings is doubtless the irritating property of the acid, and this will generally necessitate the abandonment of the method after the first three or four weeks. If the carbolic acid be employed longer, and the part still wrapped up in macintosh, it seems that the heat so generated and the irritating quality of the acid will keep up too much action and prevent union, which will then go on rapidly, if common water-dressing be substituted. But by that time even the largest and deepest wounds have usually become nearly superficial.[2]

I have thought it right to bestow so much space upon this method of dressing wounds partly from its success in my own and others' hands,[3] and

[1] Mr. Hamilton, in the paper referred to on page 12 (footnote), teaches that this serous discharge consists mainly of the normal lymph from the divided lymphatics. That it contains such lymph is indisputable; but this seems to me to bear only a small proportion to blood-serum and inflammatory fluid.

[2] Salicylic acid, boracic acid, thymol, and eucalyptus have been used in place of the carbolic acid. The two former are evidently inferior as antiseptics, and are now only used in some of the minor details of the dressing. Thymol gauze or eucalyptus gauze are often admirable substitutes for carbolic acid, being more grateful to the smell, less irritating and more absorbent. They do not, however, seem to me as powerful antiseptics as carbolic acid.

[3] It seems useless at the present time to refer to foreign testimony. The antiseptic

partly as it illustrates most of the general principles which in England are admitted as governing this part of surgery. These general principles are, to place the edges of wounds in accurate and easy contact, with no strain on the parts composing the flaps and no undue pressure on those in the neighbourhood; to provide adequate exit in a dependent situation for the products of inflammation; to give as much support to the parts as will assist in maintaining them in apposition; and, finally to protect them from the air. The latter indication, however, as I have stated above, is not *universally* admitted. In some foreign countries wounds are systematically dressed so as to exclude the possibility of primary union, the cavity being stuffed with charpie until suppuration has set in; but this seems to us to involve a needless aggravation of the traumatic fever, a needless length of the healing process, an additional risk of unhealthy action in the wound, and a less healthy cicatrix. There are wounds, however, such as the deep and large cavities left after excision of a large joint or bone, or the cavity produced by trephining or gouging inflamed bone, in which it would be useless to seek primary union, and in which, if the skin be closely united over the whole cavity, it might adhere sufficiently to obstruct the exit of the pus which must ultimately form. The best plan in such cases is to stuff the cavity with a long, broad piece of dry lint, leaving the end of it to project from the wound, which is left ununited in any convenient situation for that purpose, the rest being closed. The dry lint absorbs any blood or other fluid which may ooze from the surfaces, and can be gently drawn out after twenty-four or thirty-six hours, leaving the flaps clean and free from clot, and allowing a sufficient exit for the discharge which must ensue.

Dressing wounds which are not required to unite by first intention.

A very comfortable way of dressing almost any kind of wound is by *irrigation*, either with pure water or with carbolic lotion, or with some perfumed water. The fluid may be either warm or cold. It is suspended in a Florence flask from the bed-cradle, and a skein of lamp-wick cotton hanging out of the flask allows it to drip over the wound. By regulating the size of the wick the supply of fluid can be almost exactly proportioned to the evaporation, and a gutter made in a macintosh sheet laid under the wound will convey away any superfluity.

Irrigation of wounds

A convenient, and, I think, successful method of treating large suppurating surfaces, the discharge from which is copious and foul, was introduced by the late Mr. Callender, on the recommendation of Surgeon-Major Porter. It consists in wrapping the wound up in a large loose pad of pine sawdust (the dust from the Memel pine, or from red deal) loosely sewn up in a large muslin bag. It is well to put a layer of lint dipped in carbolised oil over the wound, in order to prevent the sawdust from finding its way into the wound, and the bag must be sewn over or quilted here and there to prevent all the sawdust from collecting at places removed from pressure. The advantages of this plan are the correction of fœtor, the absorption of foul matter, and the length of time the patient can be left undisturbed. The pads also afford support to the part, and by the introduction of a layer of shot can be made to exercise pressure on it.[1] Very similar to these are the absorbent pads recommended by

Pine sawdust pads.

method has been tried, and with wonderful success, in the unhealthy hospitals of the Continent, in military as well as civil practice, and in tropical as well as temperate climates. In proportion to the previous unhealthiness of the hospital, or carelessness of the practice, has been the comparative gain of life. But it is still uncertain whether in healthy hospitals, and with all due care on the part of the surgeon, wounds may not be treated with equal success on opposite principles. (See Dr. McVail's pamphlet entitled 'Ten Years' Surgery in the Kilmarnock Infirmary,' Glasgow, 1881.)

[1] 'Lancet,' vol. i. 1877, p. 90.

Mr. Sampson Gamgee,[1] made of cotton wool and gauze which have been deprived of the oily matter which they contain.

Sponge-grafting.

A curious and very interesting proposal has lately been made by Mr. Hamilton,[2] and successfully carried out in Edinburgh, i.e. to fill a granulating cavity with a piece of sponge, previously decalcified and carefully rendered 'aseptic' by steeping in carbolic acid. The new tissue grows through the interstices of the sponge, and fills up the wound, while the framework of sponge either disappears or remains inert. The reader is referred to the original for Mr. Hamilton's peculiar views on the intimate nature of the process of union in these cases. I do not entirely share his theoretical opinions, but have seen examples of the success of the practice.

It would be endless if I were to endeavour to discuss all the details of dressing wounds, as to every one of which the widest difference of opinion prevails even among surgeons of the same school. But a few words on some

Sutures.

of the chief points may be useful. Thus with regard to sutures. Some surgeons insist on the supposed necessity for withdrawing them very early after the operation; others, of whom I am one, believe that if an adequate exit has been provided *from the first* for the discharges (for which purpose a drainage-tube, laid in the wound during the operation, is very convenient) the sutures can hardly be retained too long—they keep the parts in easy contact, and obviate the necessity for the constant reapplication of strapping, which is in general very painful and irritating to the patient, especially to children. I have often treated cases of amputation to the end without removing the sutures till the patient left the hospital: and the stumps so formed have generally been the most satisfactory. This, of course, does not apply to wounds of the face, or any part where the marks of the suture would be objectionable. Again, with respect to the material and kind of the suture. The silver sutures are now in universal use, and are incontestably superior to any other, if they are to be allowed to remain in long; but if the sutures are to be removed soon after the operation, silk is better, since it can be removed without any pain or difficulty, whereas the withdrawal of a metal suture, whatever care be used, must, as a general rule, give a little pain. That pain, however, may be reduced to a minimum by carefully straightening the suture after it is cut, and flattening down the cut end with forceps before drawing it out. Catgut sutures are very convenient and need no withdrawal, since their buried part melts away, and then the suture drops off of itself; but for the same reason they are of no use after the first few days. Many surgeons use the continuous suture; and it answers very well if the stitches are only to be retained a few days, in which case it is perhaps best made of the carbolised catgut. The objection to it is that it is difficult to cut out a portion of it, if necessary for relief of tension or exit of discharge, without loosening the whole suture; its advantage is the accurate apposition which it ensures.

Strapping.

Other means for keeping the edges of a wound in apposition are bandages, strapping, and compresses. Strapping is absolutely necessary in many cases where the sutures have been removed or the weight of the flaps is so dragging upon them as to make it desirable to assist them by taking off the strain; and for small wounds which can be kept in exact apposition strapping is more useful than sutures. In such cases the straps should be very rarely disturbed—only when it is plainly required. So, also, when strapping is used to produce pressure in order to restrain hæmorrhage, the longer it is left on the better,

[1] 'Lancet,' vol. i. 1880, p. 127.

[2] 'Edinb. Med. Journ.' Nov. 1881.

provided no œdema of the lower part of the limb is present, and the bleeding is effectually commanded. But in large wounds, such as those of amputation, I cannot say that I am myself very fond of strapping, though I am aware that some very good surgeons use it from the first, to the total exclusion of sutures. The chief reason why I prefer the latter as a means of keeping the edges together is, that the wound thus united requires hardly any dressing, and frequently need never itself be touched; while strapping gets so soon disturbed by the discharges that it must be renewed at very short intervals, a proceeding involving no little pain in an inflamed stump.

Bandages and compresses.

Bandages are often of very great service in obviating the spasms which are so painful in large wounds, such as those of amputation. The support of a splint and bandage lightly and evenly applied seems to me a great comfort after an amputation, and in a severe wound on the thigh or into the knee I think it a very good plan to bandage the whole limb evenly from the toes. Again, bandages are very often used to prevent the retraction of the flaps which sometimes ensues after amputation, though this end is perhaps better attained by a loop of strapping well secured to the stump and acted on by a weight. Compresses are sometimes necessary, and especially in wounds which are the seat of venous bleeding or bleeding from a number of minute vessels. They should be carefully adapted to the shape of the wound, the first compress (made of about four folds of lint) exactly covering the part on which pressure is to be made, and no more. This is supported by another a little larger, and a third, of still larger size, is laid on the top, and the whole secured in its place by long strips of strapping crossed over the compress, starwise, and a firm bandage over all.

CHAPTER II.

THE COMPLICATIONS OF WOUNDS AND INJURIES—ABSCESS—SINUS AND FISTULA—PYÆMIA—HECTIC—ERYSIPELAS—GANGRENE—TETANUS—DELIRIUM TREMENS.

Abscess.

We must now consider the complications which interfere with the regularity of the healing process, and the specific diseases which, taking their rise in unhealthy inflammation or disturbed innervation excited by the injury, affect the whole system, and too often render what at first seemed a trivial accident very serious or even fatal. All of these complications also originate spontaneously from diseases of all sorts; but they are most conveniently studied in relation to wounds. We will begin with abscess, a frequent concomitant of all kinds of injuries and an equally frequent idiopathic affection.

An abscess is defined as a collection of pus enclosed in a cavity. This cavity is formed by the parts around (usually the cellular tissue) condensed by inflammation,[1] and lined by a layer of flocculent lymph, which has received the name of the 'pyogenic membrane'—a name which is so far appropriate that the layer is chiefly formed by the aggregation of the inflammatory leucocytes which are breaking down into pus, and therefore is the part from which the pus proceeds.

In studying abscess we must speak briefly of the contents of the cavity, of its mode of progress, of the kinds of abscess, their symptoms and treatment.

Kinds of pus.

The *contents* of the abscess-cavity is pus, or 'matter,' the nature of which has already been spoken of. Healthy pus is a creamy, inodorous, yellow, homogeneous, alkaline fluid. This was called by the old authors *pus laudabile*. When mixed with blood, as it often is in acute abscess, it is called *sanious*; when it has putrefied, from acute inflammation or from gangrene of the parts in which it is formed, it is termed *offensive* or *putrid*; when mixed with flakes of solid matter, *curdy* or *flaky*; and when these flakes are believed to be fragments of crude tubercle, *strumous*; when excessively thin, as in chronic abscess, *serous* or *watery*; when thin and acrid, so as to irritate the skin in the neighbourhood, *ichorous*. Finally, in rare cases, pus presents various colours—blue, green, or black.[2]

The abscess cavity.

The cavity consists internally of the layer of pus and lymph called the pyogenic membrane (which is more distinct in chronic abscess of bone than in any other kind), immediately external to which is tissue degenerated by inflammation, and containing a large number of dilated vessels, then œdematous cellular and other tissues gradually fading away into healthy parts. The enlargement of the vessels around the abscess is often so great as to give rise to

Progress and bursting.

pulsation obvious to the eye as well as perceptible to the patient. As the surrounding tissues soften and break down the abscess-cavity extends; and this usually occurs more towards the nearest surface than in other directions, until

[1] By 'condensed' I mean matted together and thickened. The consistence of these matted and thickened tissues varies, chiefly according to the acuteness of the inflammation. In acute abscess the parts are softened and lacerable; in chronic abscess, on the contrary, they are hardened.

[2] See 'System of Surgery,' vol. i. p. 99, 3rd ed.

the tissues over the pus become so much thinned that it projects and its colour can be seen, when the abscess is said to *point*, and this immediately precedes its bursting.

Kinds of abscess.

The kinds of abscess are acute and chronic, or cold, to which French authors add abscesses by congestion. The latter are such as are in contact with a diseased surface of bone, from which their matter is furnished, as is the case in spinal abscess.

The most common are the acute abscesses which depend on some definite irritation giving rise to inflammation. They advance rapidly, with pain, and, if large, with constitutional symptoms. A large abscess is usually preceded by rigors, and probably accompanied by perceptible fever. The parts around are swollen, hot, and painful, often very tense and pulsating; the pus is generally healthy, or sanious. A cold abscess advances very slowly and gradually to a large size, with no fever, and generally little or no pain; the parts around are somewhat thickened and hardened by inflammatory effusion and chronic organisation, but otherwise hardly altered, except by mere distension; the pus is usually watery or curdy.

Diagnostic signs.

The diagnosis of abscess has to be made from mere inflammation with œdema, from soft solid tumours (such as soft cancers), from cystic tumours, and from extravasations of blood.[1] The first point in the diagnosis of abscess is to become perfectly familiar with the sensation of *fluctuation*. The particles of fluid in a cavity, if not too tightly bound down by its walls, are displaced in any direction by the slightest force, and immediately return again to their former position. Thus if one hand or one finger be placed on a dropsical abdomen while any other part of the belly is tapped gently with the other hand or another finger, the wave of fluid will be plainly felt to impinge on the hand or finger which is at rest; or if the thumb be sharply pressed down on a small deep-seated collection of fluid, the fluid yields and will be felt to surge up again against the thumb. The perception of fluctuation, in either of these ways, distinguishes a limited collection of fluid like an abscess from the indefinite softness of fluid diffused in the meshes of the tissues and also from solid tumours; and the history of the case, with the presence of inflammation in its neighbourhood, will distinguish an abscess from a cyst or a collection of extravasated blood; but in case of doubt the grooved needle, exploring trocar, or Dieulafoy's aspirator will settle the question. The fallacies in detecting fluctuation are numerous. There may be fluid, but it may be so tightly bound down that its displacement is imperceptible. This is very common in small tense cysts and in hydrocele, less so in abscess, except in thecal and perinæal abscesses. There may be fluid, and in considerable quantity, permeating the tissues so extensively as to give the sensation of fluctuation, though there is no cavity. Thus inflamed soft parts are sometimes incised, under the impression that there is an abscess when it turns out to be only inflammatory œdema. This argues, to that extent, a deficiency in the *tactus eruditus* on the part of the surgeon, but it is not uncommon even with the most experienced, and often relieves the inflammation more effectually than anything else could have done. A still greater difficulty is to distinguish the sensation of deep-seated fluid from that of a soft tumour, such as a rapidly-growing cancer; in fact, it is hardly possible, so permeated with fluid is the texture of such tumours. Here, again, exploration is essential.

Fluctuation.

The diagnosis of abscess having been made, the question occurs of opening

[1] Abscesses may also be confounded with aneurism; but this will be treated of with the latter subject.

Treatment of abscess.

it. As a general rule all abscesses are better opened at once, except those which are very deeply seated, which may require less extensive incision if allowed to come nearer to the surface. In parts also where deformity is especially to be avoided, as in the neck, it may be better to wait until a mere puncture will suffice, and till the surgeon can see exactly which is the most depending part of the fluid.

There are many different kinds of abscess-knife. One of the best is that which goes by the name of Syme, a sickle-shaped blade, which is plunged into the abscess and cutting rapidly outwards makes a sufficient incision with very little pain. A small knife, which is called Pollock's knife at St. George's, but has different names with different instrument-makers, is very useful, as it makes hardly a larger puncture than an exploring-needle, and so can be withdrawn, if there be no pus, without doing any damage, yet is strong enough to open any ordinary abscess.[1] In many situations (e.g. the neck) abscesses may be very usefully opened by means of a seton. A stout thread is driven through the abscess, and kept in till the puncture is permanently established, and thus the abscess is drained off with very little mark. A fine drainage-tube is still more convenient for the same purpose. Some deep-seated abscesses (as those in the liver) are still occasionally opened by destroying the tissues over them with caustic potash, though this plan is nearly antiquated. A very useful method of opening large abscesses is under carbolic acid. A *veil* or thin rag steeped in the ordinary carbolic lotion (1 part in 40) is laid over the part, the knife is passed under this veil, and as the incision is made the veil is smoothed down over it, so that no air enters. The pus is allowed to ooze out through this veil, and in about an hour, when the discharge has pretty well ceased, the wound is dressed after the ordinary antiseptic method. Frequent washing out of the sac with carbolic lotion was recommended by the late Mr. Callender, and seems often to expedite the cure; but the over-distension of the sac which he practised does not seem to me advisable.



FIG. 5. 'Syme's' Abscess Knife.

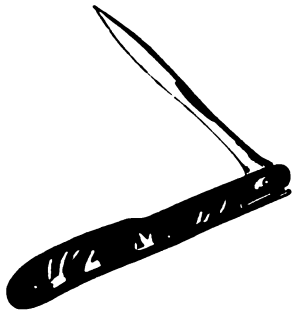


FIG. 6. 'Paget's' or 'Pollock's' Abscess Knife.

When the abscess is very deeply seated or lies in the neighbourhood of important structures, as in the neck, a very safe and valuable method is that which is especially recommended by Mr. Hilton[2] of laying aside the knife after the superficial parts have been freely incised, and breaking into the cavity of the abscess with the end of a director. A pair of forceps can then be inserted into the small hole so made, and by opening the blades the orifice may be enlarged as far as needful.

Inflammation of the cavity.

Inflammation of the cavity of a large abscess after incision is attended with very grave symptoms—rigors, fever, œdema of the parts, and putrefaction of the matter. The wound must now be freely enlarged, and the cavity washed out constantly with some antiseptic, while the patient's strength is supported with stimulants and tonics, and opium used as may be indicated.

[1] A groove is sometimes cut along the middle of the blade so as to convert the knife into a kind of broad grooved-needle.

[2] See Hilton on 'Rest and Pain,' lect. vi. Paget, 'Clinical Lectures and Essays,' p. 333.

Hæmorrhage from wall of abscess.

Another matter which should be noticed in connection with abscess is, that when opened the sides of the cavity begin to granulate freely; and often if the opening is not free enough the granulations will become congested and a continuous oozing of blood (*hémorrhagie en nappe*, as the French term it) will take place. Styptics, pressure, &c., are constantly used in such cases, and aggravate the mischief. If the cavity be laid freely open from one end to the other, and if need be by a crucial incision, the relief of the tension and the consequent exposure of the granulations to the air will at once suppress the bleeding.

Disappearance of abscesses.

Finally, it should be added that abscesses sometimes entirely disappear without bursting. If an opportunity offers for examining the part after this has taken place, a caseous, semi-solid substance called 'adipocere' is found occupying the diminished cavity and surrounded by traces of the wall of the abscess. Ultimately even this may disappear, and there may be left either a little chalky mass or nothing but a confused induration of the tissues.

Residual abscess.

In the remains of old dried-up abscesses, or in other residues of inflammation which has never advanced to suppuration, abscess is very likely to occur a considerable time after apparent recovery. Sir J. Paget has called especial attention to these 'residual abscesses' in his Clinical Lectures (p. 310). They are most common after spinal abscesses, and are also common after abscesses connected with diseased joints, but they occur in any part which remains altered and degenerated in texture—'in the thickenings, adhesions, or other lowly-organised products of inflammation long past.' The prognosis of these abscesses is, as a rule, better than that of the original disease on which they supervene. They should be opened at once.

Sinus and fistula.

Very commonly, after it has burst, an abscess remains open, but its cavity narrows into what is called a 'sinus' or fistula.

These two terms are sometimes used as synonymous, meaning a long channel like that of a pipe running through the soft or hard parts, but at other times some differences are made in the use of the words. Speaking generally three kinds of sinus or fistula are described, viz.: 1. Long narrow suppurating canals (e.g. fistula in ano, mammary sinus); 2. Canals giving unnatural exit to secretions (e.g. gastric fistula, biliary fistula); and 3. Unnatural apertures of communication between mucous canals or cavities (e.g. vesicovaginal fistula). 'If a distinction is to be made between the terms, *fistula* should be applied to the second and third of the above-named three forms of disease, and to those examples of the first form in which the suppurating canal has two openings; and *sinus* should be applied exclusively to those of the first form in which the canal has but one opening.' (Paget.) The special forms of fistula will be considered so far as they are the subjects of surgical treatment, in subsequent chapters, as fistula in ano with DISEASES OF THE RECTUM, vesicovaginal fistula with DISEASES OF THE FEMALE GENERATIVE ORGANS. We need only here occupy ourselves with those sinuous or fistulous passages which result from the imperfect healing of old abscesses. This imperfection results most commonly from some abiding source of irritation either at the bottom or in the track of the fistula, such as a piece of diseased bone or a lodged foreign body; sometimes from muscular action disturbing the parts, sometimes from the imperfect exit, causing retention of the matter and consequent inflammation of the walls of the cavity; sometimes, as it seems, from mere ill-health, interfering with the tendency of the cavity to fill up. The walls of an old sinus will always be found more or less inflamed, condensed, and unhealthy, and very frequently secondary pouches, or suppurating cavities, exist in the walls, or the sinus

divides into two or more channels which open independently of each other.

The main points in the surgical treatment of sinuses are: first to ascertain whether any foreign body is present, and if so to remove it; next to ascertain whether the sinus depends on disease of some bone, and in that case to remove the bone if loose, and if carious to treat the disease according to the rules laid down in the Chapter on DISEASES OF BONE. Simple sinuses which are kept up by the action of muscles may be cured by the division of those muscles (of which the division of the sphincter in anal fistula is a familiar example), or by pressure so applied as to keep the muscles at rest.[1] Sometimes the morbid action of the parietes of the sinus may be modified by injecting it with some irritating fluid, as the tincture of iodine or of cantharides, or by lightly cauterising it with the galvanic cautery; and the same effect may in other cases be produced by a seton or a drainage-tube. In some few cases besides those mentioned above, pressure may act advantageously by bringing the deeper or remoter parts of the sinus in contact and keeping them so till they unite and thus close the sinus gradually from the bottom. Sometimes the dilatation of the sinus with the sea-tangle tent converts it into a simple abscess which fills up. But the surest plan, when it can be thoroughly carried out, is to lay open the whole sinus and every branch of it, dissect away the indurated walls of the sinus, if necessary, and make the entire wound granulate from the bottom.

Pyæmia.

Pyæmia is usually defined as an affection of the mass of the blood characterised by a peculiar form of fever, and resulting in the formation of abscesses (secondary deposits) in various parts of the body. The cause of this affection of the blood is probably the absorption into it of putrefying material, and it is by no means impossible that some molecular change in the blood itself may cause a similar affection (spontaneous pyæmia).

The best writers on pyæmia speak of two forms or modifications of the disease: (1) the systemic infection, and (2) the true pyæmia, characterised by local changes, or 'secondary deposits.' To the former the name *septicæmia* is now very commonly applied. It is regarded by some pathologists as a different affection from pyæmia, though closely allied to it; by others (and I think with more reason) as the same disease under a somewhat different form.

Septi-cæmia.

Septicæmia is sometimes even more fatal than ordinary pyæmia, but at others it is so little dangerous as hardly to be distinguished from common traumatic fever, if, indeed, there be any distinction. Many diseases are now recognised as being similar in essence to pyæmia and septicæmia, and are grouped with them under the generic name of blood-poisoning, notably all the erysipelatous affections, the putrid sore-throat of dissectors or hospital attendants, and puerperal fever. Mr. Callender thus described the most characteristic and most acute form of septicæmia:—

'Within twenty-four hours in acute cases there are rigors, vertigo, and general uneasiness. Then follow heat, perspiration, and increased rapidity of pulse. The seat of inoculation is dusky, indurated, often pustular; or if it had been before secreting pus, the discharge ceases. Radiating from this centre, the integument is distending with a serous effusion, presently to be mingled with thin sanious pus. The swelling, generally somewhat elastic, is hard and tense over enlarging and painful glands. The blood, deranging the

[1] Some interesting and practical examples of this use of pressure are recorded by Mr. Hilton 'On Rest and Pain,' lect. vi.

heart's action, is circulated violently and rapidly through the system; exuding from its vessels, as in purpura, it stains the surrounding tissues, forms ecchymoses in internal organs, or is poured out upon mucous surfaces, and is then chiefly removed by purging or vomiting. In another twenty-four hours the patient, flushed, anxious, restless, even delirious, is in a hopeless condition, with prostration and rapid sinking.'[1]

This is an excellent and faithful description of the most rapid and most hopeless cases of blood-poisoning, such as occasionally follows on dissection-wounds. In less acute cases, the symptoms are those of ordinary, but severe, traumatic fever; and sometimes in these less acute cases of what is at first diagnosed as septicæmia, secondary deposits occur, proving the identity or at least the close similarity of septicæmia and pyæmia.

The disease, however, to which the term pyæmia is universally applied is one of so very well-marked a character, so frequently fatal, and when fatal usually marked by such unmistakable morbid appearances, that it is very strange how it could have escaped the observation of so many famous physicians and surgeons down to the time of Mr. Arnott.[2] Its accession is usually marked by very definite symptoms of fever—rigors, recurring at intervals sometimes so regular as to be mistaken for ague, and usually followed by colliquative perspirations; bilious aspect of the countenance, the so-called pyæmic jaundice,[3] frequent and small pulse, and numerous other symptoms, varying with the part on which the stress of the disease falls. Thus, when the circulation of the brain is affected, there may be delirium; of the intestines, diarrhœa; of the lungs, dyspnœa, and so on; but very commonly the recurring rigors and the consecutive perspirations, marking a persisting fever for which there is no explanation in the local conditions, are the only prominent symptoms. The local conditions, indeed, as shown by the state of the wound, are often indistinguishable from those of an ordinary healing ulcer, though there are no doubt cases in which the granulations turn grey and wither and the discharge becomes ichorous. The state of the tongue is also very variable. But the persistence of a considerable amount of fever from day to day, such as is shown in the accompanying thermograph, after a wound or injury, is always suspicious, and usually indicates the absorption of poisonous matter into the blood. In fact, unless there is some specific affection, or some evidence of deep-seated suppuration, it is difficult to explain the occurrence of this fever otherwise. A comparison of the thermometric chart on the next page with those of simple traumatic fever (on p. 19) and of hectic (on p. 38) will show the following differences. In traumatic fever, which depends on the application of a definite 'stimulus' to the blood, whereby its heat is raised above the normal, there is a more or less abrupt rise so long as this stimulus acts until the climax is reached, when it is succeeded by a gradual defervescence, and the temperature comes back to the normal, and so remains. In hectic there is a recurrence of the feverish condition regularly once or twice

Temperature in pyæmia.

[1] 'System of Surgery,' 2nd ed. vol. i. p. 254. Let the reader compare with this the account given by Dr. Burdon Sanderson of septicæmia as produced in an animal by the injection of a septic fluid ('Brit. Med. Journ.' 1877, vol. ii. p. 913).

[2] The accurate study of Pyæmia may be said to date from the essay published by this surgeon, 'On the Effects of Inflammation of Veins,' in the 'Med.-Chir. Trans.' vol. xv., in the year 1828.

[3] This yellow tinge of the surface in pyæmia is not usually so marked or so universal as in true jaundice. When the latter symptom is well-marked there is reason to suspect secondary deposit in the liver—though this is not always found—sometimes only inflammatory softening. See Billroth, 'New Syd. Soc.'s Transl.' ii. 53.

a day quickly followed by sweating and a fall to the normal temperature. In pyæmia there is a constant exaltation of the natural temperature, but with irregular exacerbations (at the times of the rigors), the temperature, however, remaining above the normal all the time.

The local suppurations come on at most irregular periods, and affect the most various organs. There is probably no organ of the body which is not sometimes attacked by the pyæmic inflammation, though the liver, lungs, and joints are those most commonly implicated. The symptoms caused by these local inflammations are often very slight. Dyspnœa may be present to a less or greater extent when the pleural cavity or lung is inflamed, pain under the ribs or jaundice in affection of the liver, pain and redness in the neighbourhood of affected joints; but such symptoms are usually much slighter than in healthy inflammations, and pyæmic abscess is constantly found after death in organs where there has been no reason to suspect it during life.

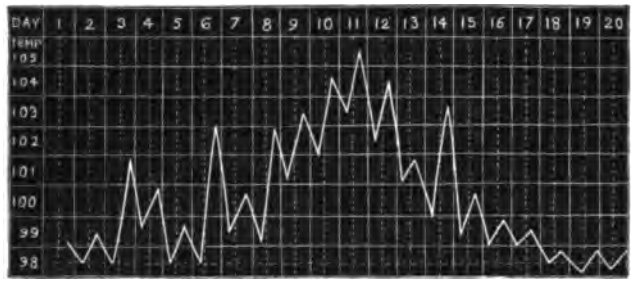


FIG. 7. Thermograph of Pyæmia terminating in recovery. The first rigor which was observed took place on the 8th day.

Causes of pyæmia.

Pyæmia is liable to follow almost every injury to which the body is exposed, and every disease by which decomposing substances can be presented to absorbing surfaces. But there is no doubt that it is caused in the great majority of cases by injuries in which the vessels of bone are laid open, and exposed to the contact of inflammatory products, and by such injuries or diseases as affect the main veins. Thus compound fractures, excisions, and amputations (which may be regarded as kinds of compound fracture), severe contusions and contused wounds producing thrombosis of large veins, parturition which exposes the great venous channels of the uterus to the contact of decomposing matter, erysipelas, diffuse inflammation, phagedæna, diffuse or acute periostitis, and acute inflammation of the interior of bones, are among the most frequent exciting causes of this affection.

Contagiousness of pyæmia.

The most interesting question practically in connexion with the ætiology of pyæmia is whether and how far it can be caused by contagion. Its prevalence in unhealthy hospitals, and especially lying-in hospitals, has been used as an argument to prove that its main cause is contagion, and this view has been supported by the alleged fact of the absence of pyæmia from private practice. This latter allegation has, however, been satisfactorily disproved. Pyæmia is certainly met with in private practice, and Sir J. Paget goes so far as to say that he has met with as considerable a prevalence of pyæmia in private as in public practice. Nor have I ever seen anything in hospital practice to lend any support to the view that pyæmia is usually propagated there by contagion. Cases of pyæmia are frequently admitted into hospital, and I have never seen it spread from such cases. Nor have I ever been able to verify any spread of the disease from the sporadic cases which originate in hospital,[1] and which in

[1] Very erroneous and exaggerated statements are published, as to the extent to which

St. George's are never isolated in any way. Without, therefore, denying the contagiousness of pyæmia, which is asserted by so many eminent authorities, I think I may say that it is so slight as to be easily neutralised by proper precautions, at least in a general hospital. Among those precautions the most scrupulous care in dressing the wounds is certainly the most important.

Pathology of pyæmia.

There are several different explanations of the pathology or generation of pyæmia, but of these the one which was first accepted, and which rested on the great authority of Cruveilhier—viz. that it depended on the passage of pus-globules into the blood—is now exploded.[1] The known fact that pyæmia can originate spontaneously when no pus is present in any part of the body would alone disprove this idea, which is also inconsistent with the early morbid anatomy of the deposits.

It appears now to be admitted that the essence of pyæmia consists in the imbibition, by the blood, of matters in a state of putrefaction, which act as a ferment on the blood, and cause it to stagnate in the capillaries. To this fermentation is due the feverish condition which is present during the whole period of the disease. To the stagnation of the blood in the capillaries of the part is due the formation of the secondary deposits.

Secondary deposits.

The original stage of a secondary deposit is that in which the capillaries or veins of the parts are loaded with coagulated blood (thrombosis), and to this succeeds an inflammatory stage in which the parenchyma becomes loaded with the products of inflammation, and with blood ('hæmorrhagic infarct') to which succeeds suppuration, and so an abscess results. The process on a free surface is the same, though the details may be somewhat different, the inflammatory products being poured out on to the surface of the mucous or serous membrane, soon succeeded by a collection of thin pus in the cavity.

So much is admitted on all hands; the more difficult questions, What is the putrefying material? and, How does it get into the mass of blood? are hardly as yet settled. It seems certain that it frequently results from plugging or 'thrombosis' of some distant vein, the effect of injury or irritation. This thrombus may decompose and break down, when the disintegrated and decomposed fibrine may be carried into the venous current, as shown by the annexed diagram. It is also quite conceivable that the putrefying discharges on the free surface of a wound may be absorbed into the blood and thus excite the same consequences. This, however, does not explain the cases of spontaneous

pyæmia prevails in our surgical hospitals in London. I have referred to the published Reports for the three years 1874 to 1876, from St. Bartholomew's and St. George's Hospitals. At St. Bartholomew's I find that there were in those three years in the surgical wards twenty-two cases of pyæmia, six at least of which originated outside the hospital. The number of surgical patients in these three years was 9,730, of whom 518 died. At St. George's in the same three years there were eleven cases of pyæmia, three of them originating outside the hospital. The number of surgical patients in these three years was 5,651, of whom 315 died. This certainly does not testify to any prevalence of pyæmia from contagion in either of those hospitals. I may say the same of erysipelas. The total number of cases in a well-ordered metropolitan hospital is small—the majority originate outside of the hospital—and so spreading of the disease by contagion is to be traced. At St. George's in the same three years 100 cases of erysipelas in its various forms originating outside the hospital were admitted, and ninety originated in the hospital. This refers exclusively to the surgical wards. Cases of erysipelas and pyæmia are to be found also in the medical wards, but almost all of these originate out of the hospital.

[1] Cruveilhier's explanation was founded on an experiment in which he injected a globule of mercury into a vein in a bone; the globule was detained in the lung and became the nucleus of an abscess. He concluded from this and other experiments that the pus-globules pass from the suppurating surface up the veins in the same way as this globule of mercury did, and are detained in the capillaries of remote organs, generally the lung.

pyæmia, where, without any known injury or any ulcerating surface, symptoms of blood-poisoning come on, followed by secondary abscesses in various parts.

On this subject Billroth speaks as follows :—

'At present there is probably no doubt that it is usually due to reabsorption of putrid fluid or pus; that it is always so is, indeed, disputed. Many surgeons assert that pyæmia very frequently results from miasma, especially from a miasma which developes from the wounds of many patients lying together. This view is based chiefly on the fact that where many severe surgical cases lie together (as in large hospitals, especially army hospitals), many of them die of pyæmia, and that even mild cases, patients with cicatrising granulating wounds, become pyæmic under such circumstances. This is no place for polemics, hence I must be content with giving you my own views on the subject. I can entirely agree to the miasmatic origin of pyæmia, if by miasma is understood what I understand by it in the present and some other cases, namely, dust-like, dried constituents of pus, and possibly also accompanying minute, living, very small organisms, which in badly-ventilated sick-rooms are suspended in the air or adhere to the walls, bedclothes, dressings, or carelessly-cleaned instruments. These bodies, which are in some respects of different nature, are usually phlogogenous, all pyrogenous,[1] when they enter the blood. Of course they will collect chiefly where there is the best opportunity for their development and attachment, that is, in badly ventilated sick-rooms, where the patients are carelessly attended, where there is deficient cleanliness, and the patients remain some time in the same apartments. It is impossible to say whether all pus, moist or dry, is alike injurious; experiments on animals give us no information on this point. It is possible that dry pus, as well as moist, acquires peculiarly injurious qualities from certain minute organisms, animal or vegetable.'[2]

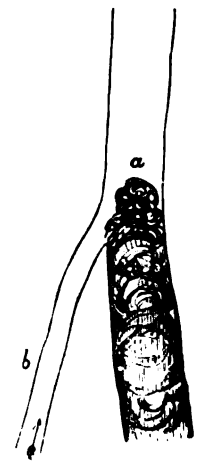


FIG. 8. Diagram of a Thrombus in a vein. From Billroth. *a*. Central end of a venous thrombus projecting into a large trunk. *b*. A branch without thrombus; the blood flowing through it may detach and carry into the circulation the end of the thrombus *a*.

Pathological anatomy.

The pathological anatomy of septicæmia and pyæmia may be thus very summarily described :— 1. In some cases (septicæmia) no distinctly localised appearances are discovered; the spleen, the solitary glands of the intestine, and the lymphatic glands may be found swollen, the blood hardly coagulated, and the tissues prone to rapid decomposition, and thereby somewhat altered in microscopic appearance. 2. In other cases (more distinctly pyæmic) the appearances are localised in the synovial and serous cavities, as diffuse sero-purulent inflammation of the pleura, pericardium, peritoneum, or endocardium, without any perceptible inflammation of the organs which they cover, or as similar affections of the joints. Heiberg notices that when the pyæmia follows on childbirth (puerperal fever) such inflammation may be found in the peritoneum without any affection of the walls or lining of the uterus. 3. In the

[1] By 'phlogogenous' is meant 'capable of exciting local inflammation;' by 'pyrogenous,' 'capable of exciting general fever.' See pp. 17, 18.

[2] Billroth, 'Surgical Pathology,' transl. by Hackley, pp. 358–9. The Syd. Soc.'s Transl. vol. ii. pp. 59–60, contains the same passage, but the most important sentence has been rendered unintelligible by a mistranslation.

third form the morbid material shows its affinity for the mucous membranes, and chiefly that of the alimentary canal, by which it seems, as it were, to seek for elimination. The appearances are those of catarrh of the membrane, with swelling of the solitary and agminate glands. This is the form which is usually seen in animals after the injection of putrid matter into the blood. 4. The fourth form is that in which numerous metastatic abscesses are formed, such metastatic abscesses being usually, but not always, preceded by embolic clots in the minute vessels.

Bacteria in blood-poisoning.

The above is summarised from a very able tract by Heiberg, of Christiania,[1] which may also be consulted for a demonstration of the presence of bacteria in these pyæmic deposits and in all parts where the pyæmic or septicæmic process is perceptible. He appears to regard these bacteria as in some way an integral part of the matter (the 'materia peccans,' as he terms it) which sets up the fermentative action in the blood; and he endeavours to trace the bacteria along the venous and the lymphatic system from the point of inoculation into the general mass of the blood, i.e. to the great veins and the heart. This view would explain the cases of apparently spontaneous pyæmia as being instances where the morbid matter was accidentally implanted on some part of the external integument, or alimentary mucous membrane, or respiratory tract accidentally denuded of its normal epithelium; so that the 'peccant substance' (the presence of which is indicated by the bacteria) is allowed to find its way into the lymph-channels, and so into the blood.

At the same time it must be admitted that our knowledge of the connection which may exist between the bacteria which are found extensively in decomposing fluids and tissues, and the symptoms (called septicæmia, pyæmia, &c.) which may be caused by the absorption of putrefying products, is at present very limited. An interesting article by Panum, of Copenhagen,[2] may be referred to as showing that such putrid fluids retain their poisonous properties after undergoing processes by which all bacteria must be destroyed,[3] and that the mode of their action is much more analogous to that of some compound chemical product than to the propagation of an animal or vegetable parasite. But even if the bacteria themselves be not the vehicles of the poison, there remains the possibility that the bacteria may have been in some way the cause of the poisonous property of the matter. And this possibility Panum admits, representing it hypothetically by the assumption that the 'putrid poison' may be the secretion of the bacteria; and he points to the practical fact, which is alone of extreme importance, that the same precautions which will prevent the development of bacteria will hinder the formation of the poison.

More recently this subject has been discussed with eminent ability by Dr. Burdon Sanderson,[4] who inclines to the same opinion as that admitted by Panum. Dr. Sanderson believes that for the development of septicæmia the action of bacteria is necessary; but he allows that it has been proved that bacteria are present in the healthy body, and in the secretions of wounds which are at the time perfectly free from unhealthy action, and even sometimes in wounds while going on well under antiseptic treatment. From these facts, as

[1] 'Die Puerperalen und Pyämischen Processe.' Leipzig, 1873.

[2] 'Das putride Gift, die Bakterien, die putride Infection und die Septicämie.' Langenbeck's 'Archiv,' vol. xvi. 1874.

[3] It has been suggested, however, that though bacteria themselves are easily destroyed, yet their spores or seeds may resist even extreme heat. See Dr. Roberts's interesting lecture on 'Contagium vivum,' 'Brit. Med. Journ.,' 1877, vol. ii. p. 168.

[4] 'Lectures on the Infective Processes of Disease,' 'Brit. Med. Journ.' 1877, vol. ii. and 1878, vol. i.

well as from the results of experiment, Dr. Sanderson is led to the conclusion that the rod-like bodies properly called 'bacteria' are themselves inert, but that their disintegration leads to the formation of some unstable albuminous or proteid compound accompanied by the development of spheroidal bodies, or micrococci (coccobacteria), which are usually found held together by a scum or glutinous pellicle on the surface of the liquid in which they are grown. Dr. Sanderson, however, holds that in practice some other element is necessary for the generation of infection in the body—that the soil must be prepared, as it were, for the seed by some constitutional change or some change in the mass of the blood. He adduces experiments which render it probable that a disintegration of the white corpuscles of the blood may be one at least of the ways in which such a change may be brought about. Dr. Sanderson's lectures are worth reading, not only on account of their intrinsic value, but as originating a kind of 'modus vivendi' between the germ-theory of disease as taught by Lister and the chemico-physical theory adopted by Billroth and other eminent surgeons. One set of observers would assert that the antiseptic method of dressing obviates pyæmia by hindering the growth or the development of the bacteria which they regard as the originators of the infective process. The others would say that the antiseptic and all other good methods of treatment prevent pyæmia by preventing the changes without which the bacteria are harmless.[1]

The recent investigations of Koch should be at any rate mentioned here, though as yet they have not been either confirmed or refuted; so that they are to be regarded more as a speculation than as a doctrine. He has invented a method of staining and of illuminating microscopic preparations, by which the minute organisms are made much more visible than used to be the case, and he would on this account reject such experiments as those of Panum above quoted, as being deficient in the fundamental proof of the absence of bacteria. The great outcome of his experiments is, that blood-poisoning or septicæmia is to be divided into two classes: *first*, 'septic intoxication,' a disease caused by the poisonous properties of putrefying fluid imbibed (or injected) into the blood. This is analogous to any other form of poisoning in the fact that the symptoms vary in intensity with the amount of the dose; and it is in no respect contagious to others or auto-infective. The *second* is the true 'septic infection' in which a poison is developed in the blood, resembling the poisons of the zymotic fevers in the fact that the smallest dose of it will poison the whole mass of the blood, and so contagious that the least scratch with a scalpel contaminated with the blood of an infected animal, will set up the disease in a second, and similarly in a third, and so on through a series of any length.[2]

Koch also connects these phenomena with the presence of certain bacilli, as cause and effect, but perhaps enough has been said (on p. 7) on that subject in the present condition of our absolute knowledge.

Diagnosis of pyæmia.

The diagnosis of pyæmia is not by any means easy in all cases, or even possible at first, since its early symptoms are identical, or nearly so, with those of the severer forms of traumatic fever. Indeed, there can be little doubt that, since they are due to similar causes, there is no essential difference between a case of acute traumatic fever and one of the so-called septicæmia, nor does post-mortem examination detect any difference in their effects. But the

[1] See also the debate at the Pathological Society, reported in the 'Brit. Med. Journ.' April 10, 24, and May 8, 1875.

[2] Koch, op. cit. Clutton, 'Syst. of Surg.' 3rd ed. vol. i. p. 182.

characteristic difference between these forms of wound-fever is this, that in the simple traumatic fever there is a distinct rise up to the climax and a distinct defervescence and return to health. Recurring traumatic fever is only a repetition of this process, usually due to a repetition of the irritation, as from retained matter or impacted foreign body. In the constitutional infections, on the other hand, to which the names of septicæmia and pyæmia have been given, there is no such definite course of the fever. The temperature maintains itself above the normal, and is exacerbated from time to time when the rigors take place, falling again as the sweating goes on.[1] It is, then, by this course of the temperature, or by the recurring rigors and sweats which are its more palpable indications, that we diagnose pyæmia previous to the occurrence of visible deposits or internal inflammations, recognisable by their symptoms.

Prognosis. The prognosis of pyæmia is, as a general rule, very bad; that recovery does ensue, however, we have the most ample proof, and it appears to occur more frequently in cases of spontaneous pyæmia than in those of traumatic origin, and is always more probable the more chronic is the course of the symptoms.

Treatment. The treatment of pyæmia, like that of traumatic fever, really resolves itself into prophylaxis, as to which enough has been said above. None of the various plans of specific treatment which have been proposed, as by quinine, mercury, alcohol, or opium, appears to exert the least real influence on the disease itself. All that can be done is to support the patient's strength, and treat the symptoms as they occur. When abscess forms in an accessible situation it should be opened, but not by too free an incision.

Chronic pyæmia. The above description applies to acute pyæmia as we ordinarily see it, especially in surgical practice, as occurring after severe injuries, particularly those in which bones are involved. It is an acute disease, and its course is usually to be reckoned by days, rarely extending to some weeks. But pyæmia occurs also in a chronic form, of which Sir J. Paget has given, in the paper which commences the first volume of the 'St. Bartholomew's Hospital Reports,' an excellent description, and some very striking instances, in one of which the symptoms were protracted over three years. The essential features of this form are similar to those of acute pyæmia, and with proper attention the diagnosis can usually be established; but the resemblance both to rheumatism and to hectic fever is much greater than in the acute disease, especially to hectic, which in fact may supervene. The disease is not so dangerous as the acute affection, and it is frequently spontaneous, or at least independent of any traumatic cause. Sir J. Paget has noticed that 'the local evidences of chronic are more frequently than those of acute pyæmia seated exclusively or chiefly in different parts of the same tissues [as, for instance, if occurring as a consequence of disease of a bone, all the secondary inflammations may affect the osseous system only]; that they are more frequent in the trunk and limbs than in internal organs, and when seated in the veins are most frequently found towards the close of the disease.' And he adds a most important practical point, in which chronic pyæmia agrees with hectic, viz., that in this, as in hectic, the removal by operation of the seat of the original disease is frequently so beneficial that it becomes the surgeon's duty to perform the operation, whilst in the acute stage of pyæmia operations almost always deprive the patient of the faint chance of life he might otherwise have.

Hectic fever. Clearly distinguished from the previous forms of fever, which all run a

[1] See the thermograph of pyæmia, supra, p. 32; and of traumatic fever, p. 19.

definite course, is the feverish condition called 'hectic' or 'suppurative' fever,[1] which runs no definite course, and tends to death by exhaustion. It is generally caused by profuse and long-continued suppuration, but may be occasioned by anything which causes a greater expenditure of the elements of nutrition than can be supplied to the blood.

Its symptoms are arranged, for convenience of description, into three stages, between which, however, there is no exact separation :—



FIG. 9. Thermograph of Hectic Fever. From a case of pelvic inflammation after parturition, which ultimately ended in recovery.

In the first stage there is loss of flesh, varying and feeble pulse, the skin is dry and becomes hot towards evening, when the patient feels chilly, and the general temperature rises; there are profuse night-sweats with morning remissions; the tongue is clean and red.

In the second stage the emaciation is greater, the hectic flush begins to appear (that is to say, a circumscribed red blush on the cheek strongly contrasted with the clear pallor of the complexion, and lasting so long as the hot state continues), the night-sweats are much more profuse —'colliquative,' as they are termed—and there is often diarrhœa; the rise of temperature at night is more marked to the thermometer: 'the urine after the sweating will be found to contain increased quantities of urea,[2] chloride of sodium, sulphuric acid and water.' (Croft.)

The third stage is one of still more marked exhaustion and failing powers; the pulse feebler and more rapid, the skin dry and scaling, the motions loose and sometimes passed involuntarily, the urine offensive, the mouth aphthous; the chills and sweats are more frequent, occurring sometimes twice in the twenty-four hours; the legs become œdematous, bed-sores are apt to form. In some cases consciousness gradually departs before death. The patient dies very gradually, sometimes almost imperceptibly.

This condition differs entirely from traumatic fever, since it does not depend on any definite irritation, and runs no definite course; and from pyæmia in the same particulars, and also in the absence of any imbibition of poisonous materials by the blood.

The treatment of hectic must generally be directed merely to keeping the patient alive, in the hope that the source of suppuration will dry up, and on the cessation of the cause the hectic fever will subside. But there are a few cases, mainly those of suppurating joints and bones of the limbs, in which the source of suppuration can be removed by operation, and if this is to be done, it should always be done as early as possible in the disease. At later stages the patient is too weak to bear the shock of an operation. In the majority of cases where the source of this disease cannot be removed (of which the hectic ensuing on psoas abscess is a familiar example) the patient's strength must be supported, and albuminous materials supplied to the blood while the disease is

[1] Billroth has applied the term 'suppurative fever' also to pyæmia.

[2] In all these fevers [i.e. in all traumatic and suppurative fevers] the quantity of urea is always greatly increased, and generally exceeds the quantity of nitrogen contained in the food. At the same time the weight of the body decreases considerably. Billroth, ii. 40.

passing over. Small quantities of nourishing food, wine or beer, repeated as often as the patient can bear it without making too strong calls on his digestion, quinine, sulphuric acid, and iron to check the feverish exacerbations and the sweats, and opium to stop the diarrhœa and procure sleep, are the chief indications of treatment.

Suppurative degeneration of viscera.

Long-continued suppuration may also prove fatal by inducing disease of the abdominal viscera, chiefly the kidneys, liver, and spleen. It is now universally admitted that the condition which was originally described as 'waxy,' or 'lardaceous' disease of these viscera, and afterwards, not very correctly, as 'amyloid degeneration,' is often caused by long-continued suppuration, and this degeneration of the liver and kidneys is a frequent cause of dropsy and thereby of death in patients labouring under exhausting suppuration, whether with or without hectic fever. Dr. Dickinson, to whom we owe, I believe, our first accurate statement of the cause of this degeneration,[1] traces its production to the great loss of the alkaline salts of potash and soda from the blood in order to form pus. He points out that the alkalinity of pus is due to its containing about twice the quantity of the salts of potash and soda which are contained in the serum of blood; that the waxy or lardaceous viscera always contain a decidedly smaller quantity of such salts than are contained in the healthy viscera, and that the so-called 'amyloid' reaction may be artificially manufactured by depriving fibrine of the alkali with which it is naturally combined. From which he concludes that the loss of alkali from the blood, through long-continued suppuration, disposes to the deposit around the minute vessels in the affected organ of the substance displaying this so-called 'amyloid' reaction. At any rate, I think the fact is now certain that long-continued suppuration does produce such waxy degeneration, and in this way may indirectly cause death—an additional motive for ridding the patient of the source of incurable suppuration, whenever that is possible.

Erysipelas.

The term *erysipelas* is applied to a spreading inflammation of the skin, mucous membrane, or connective tissue beneath them; and the disease is divided into two chief varieties—simple or cutaneous erysipelas, in which only the skin or mucous membrane is implicated, and phlegmonous erysipelas or diffuse inflammation, in which the connective tissue is the part mainly involved. Some writers also describe a third variety—diffuse cellulitis—in cases where the integument is not inflamed at all; for instance, the diffuse inflammation of the pelvic cellular tissue which sometimes follows surgical operations.

Erythema is an affection having much resemblance to erysipelas, but differing from it in the fact that in erythema there is no necessary constitutional complication, and that the redness of erythema is not accompanied by any definite sign of inflammatory exudation, which is always the case in erysipelas.

Erythema.

Erythema is usually a mere local affection, and might perhaps be appropriately enumerated amongst the skin-diseases; but as it is advisable for purposes of diagnosis to state its distinctive features in this place, I will here mention its chief varieties and their treatment. Erythema is defined as a superficial redness, from injection of the capillary vessels of the skin. As in erysipelas, the redness disappears on pressure, and in some cases it is accompanied by a little thickening of the tissues of the skin. In some forms of erythema, however, this thickening or œdema is the cause and not the conse-

[1] 'Med.-Chir. Trans.' vol. l. p. 39.

quence of the injection; the latter, in fact, is due to passive and not to active congestion. Such is the case in the E. læve or œdematosum, the redness of œdematous skin; and this is be remedied mainly by position, the removal of any cause of obstruction, warm astringent lotions, and the cautious and dexterous application of pressure. E. intertrigo is somewhat allied to this; it is the redness which attacks the surface where large folds of skin and fat rub against each other, as in the pendulous bellies of very fat people, or in the groins of infants. The scorch of a sunburn or other irritant is somewhat of the same kind. Cleanliness, the avoidance of friction, powdering the part, and brushing it with nitrate of silver lotion or some other astringent, will relieve it.

Erythema læve and intertrigo.

Erythema fugax.

There are many other forms of erythema which, though they are in themselves local, yet own a general cause. The most obvious and familiar instance of this is the 'chloroform or ether-rash,' which is so often seen on the chest and other parts in young people of delicate skin—a slight erythematous eruption which very quickly fades away. The late Dr. Murray observed often a swollen condition of the thyroid gland during its appearance. This of course requires no treatment. In other cases erythema fugax appears as a consequence of indigestion, especially from eating shell-fish or pork, in persons to whom such food acts in a poisonous manner, or as a complication of various diseases in which the digestive system is disturbed. The knowledge of the cause points out the treatment.

Erythema circinnatum, marginatum, papulatum, and tuberculatum.

There are other special forms of erythema which are more persistent, and which more nearly approach the characters of the definite skin-eruptions, especially roseola. Such are the Erythema circinatum and marginatum,—definite rings, patches, or spots of redness, very hardly if at all distinguished from roseola when occurring in a similar form; Erythema papulatum, in which the spots are raised up into a sort of pimple; Erythema tuberculatum, in which the prominence of the spots is greater, and in which they are more persistent. This form is usually seen as a symptom in the debility of fevers. It forms the transition to the Erythema nodosum, which is not uncommon as a substantive disease.

Erythema nodosum.

Erythema nodosum differs so much from the usual forms of erythema that it is doubtful whether it ought to be included among them or classed with affections of the lymphatic system. It occurs in the form of raised patches or tubercles of a red or reddish-yellow colour, and somewhat tender to the touch, sometimes accompanied with a good deal of smarting pain. The patches are generally about the size of half a nut, sometimes as large as the fist. They are seated most commonly on the legs, but they may affect any other part; and Hebra speaks of cases in which as they disappear at one part they occur at another till the whole body has been implicated. They never suppurate, and the redness of the individual tubercles never spreads to the skin around them, a character which is peculiarly distinctive of erythema nodosum. 'It is very probable,' says Hebra,[1] 'that in its pathological anatomy E. nodosum is allied to absorbent inflammation, and likewise to the erysipelatous diseases,[2] and the same thing may perhaps be said also of the other erythemata. Indeed, it admits of no doubt whatever that the morbid process concerned in some cases of Erythema nodosum is essentially an inflammation of the lymphatic vessels.' The disease more often affects young women suffering from menstrual irregularities than any other class of persons, though men suffer from it also, and

[1] 'Diseases of the Skin,' translated for the New Syd. Soc., vol. i. p. 291.

[2] We shall see presently how close is the connection between erysipelas and inflammation of the absorbents.

children sometimes.[1] It is usually connected with some obvious disturbance of health, and may be accompanied with more or less symptomatic fever. The treatment consists in the restoration of the general health, and in alleviating the pain by position and by mild soothing warm applications.

We must now turn to the varieties of erysipelas, which are distinguished from these various forms of erythema both by the local characters of the eruption and by the presence of a definite form of general fever.

Cutaneous erysipelas.

The *cutaneous* or simple erysipelas is a spreading inflammation of the surface of the skin, with thickening of its tissue, and sometimes considerable puffiness of the subcutaneous parts. This puffiness is especially marked in erysipelas of the face, where the features swell so much and so rapidly that the patient is quite irrecognisable in a few hours, and loses all power of vision from the swelling of his eyelids. The redness of erysipelas is usually of a bright tint, often mottled, disappearing on pressure; it has a defined border, which, however, shifts continually as the eruption advances or recedes, and the surface, especially on the face, is often studded with vesicles or blebs. There is often a good deal of tingling pain in the part, and swelling of the absorbent glands is a very common phenomenon. In fact, the glands have often been found enlarged before the eruption shows itself; and if these enlarged glands be more carefully examined, tenderness will often be detected in the course of the lymphatics which lead to them. These symptoms are only the local manifestations of a general disorder of the system, as shown by the fever which accompanies them. There is almost always a rigor, often several, at the commencement of an erysipelatous attack; the tongue is usually coated and often dry, the pulse rapid, the patient restless and feverish, appetite bad, bowels constipated, urine high-coloured and often slightly albuminous.

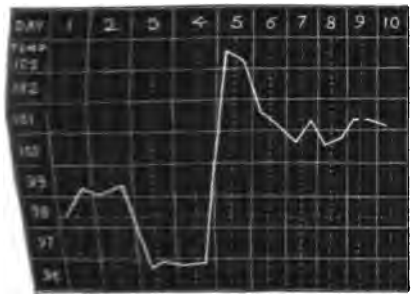


Fig. 10. Thermograph of Erysipelas.

The rise in temperature, as seen in the annexed thermograph, is often very abrupt, and the defervescence frequently as rapid. The course of the temperature in uncomplicated erysipelas (such as is shown in the chart) differs from that in traumatic fever in running a much less regular course, and usually subsiding more rapidly and abruptly; and from that in pyæmia in not presenting those constant exacerbations and depressions which mark the rigors and sweats of pyæmia. But erysipelas so frequently supervenes on traumatic fever, and is so frequently complicated with local and general disturbances (notably with the formation of abscess and with the transition to pyæmia), that its temperature-curves vary very considerably.

There is an interval between the first feverish symptoms and the appearance of the rash which is said sometimes to be as long as four days, but which I think is rarely more than twenty-four hours. The fever ought to subside considerably in a few days. If the pulse and temperature keep up beyond about ten days, and particularly if there is a rapid and considerable rise after a week, the case may be expected to terminate fatally, though I have seen exceptions to this rule. Disturbances of digestion are very common in erysipelas, so that sometimes the rash is mixed more or less with the colour of bile, and the

[1] Cases of this disease in childhood will be found related by Dr. Goodhart, 'Guy's Hospital Reports,' vol. xv.

conjunctivæ are slightly jaundiced, and this is sometimes described as 'bilious erysipelas,' though it hardly seems to require a separate name. Conversely, bilious disturbance is occasionally an exciting cause of erysipelas, so that persons predisposed are very liable to have an attack of erysipelas from disturbance of the liver. Erysipelas lasts an uncertain time, generally fading gradually and disappearing with desquamation of the epidermis; but sometimes vanishing suddenly in one part of the body to appear in another—*erratic* erysipelas. Suppuration often follows in the cellular tissue, or in the glands which were originally inflamed. There are, again, cases in which no preliminary affection of the lymphatics or of the glands precedes the attack of erysipelas, but in which the erysipelas itself originates the inflammation of the absorbents. In fact, the connection between spreading erysipelatous inflammation of the skin and the similar inflammation of the absorbents is, as might have been anticipated, an extremely close one; and this illustrates what was said above of the close connection between erythema nodosum, erysipelas, and absorbent inflammation. As the case progresses the constipation often passes into diarrhœa, the feverishness gives way to lassitude and exhaustion, and death by asthenia is threatened.

Kinds of cutaneous erysipelas.—Numerous varieties have been described by authors, more indeed than there is any practical necessity for distinguishing. I see no object in describing as distinct varieties more than the *E. ambulans*, in which the rash spreads rapidly over the greater part of the whole body; the *E. erraticum*, in which it leaves one part to appear in another; and the *E. metastaticum*, in which, after the subsidence of erysipelas of the skin, an affection, presumed to be of an erysipelatous nature, is developed in internal organs, which, however, is certainly very rare, if indeed it has any existence apart from general blood-poisoning,

Phlegmonous erysipelas or diffuse cellular inflammation.

In *phlegmonous erysipelas* the skin is less, and the subjacent cellular tissue much more, affected than in the simple cutaneous form, not that in the latter the cellular tissue is usually quite unaffected, as the swollen features of erysipelas of the face show. The general symptoms of phlegmonous erysipelas or 'diffuse inflammation' are much the same as those of cutaneous erysipelas, but more intense; the redness is usually deeper in colour, the skin more brawny, and the part is œdematous and sometimes very tense. In a few days it becomes boggy, from the formation of matter. This is often accompanied by renewed rigors, and the skin frequently sloughs, sometimes to a very great extent. Thus I have seen the whole scalp perish, exposing the entire vertex of the cranium in a case of diffuse inflammation of the head. The destruction from suppuration and sloughing often extends very deeply and very far, opening into the joints, destroying muscles, exposing bones, &c.

Diffuse cellulitis is a variety of this in which the skin is almost or entirely exempt, or which attacks the cellular tissue in a part where there is no skin. In some forms, especially in those rapidly fatal cases which have been known to follow dissection-wounds, the disease evidently has a very close relationship to pyæmia, and the rapid occurrence of death shows that the general mass of the blood is affected. In such cases it does not necessarily spread from the wound, but appears at a remote part of the limb, or even on the opposite side of the body. And in other cases diffuse cellulitis accompanies or precedes traumatic gangrene, the limb being mottled with patches of a dark red colour, which, when cut into (in amputation, for example), are seen to consist of patches of cellular tissue loaded with serum and a dark-coloured sanious lymph. The inflamed cellular tissue in such cases rapidly sloughs, involving the skin in its destruction.

Causes of erysipelas.

The causes of erysipelas may be separated into the *predisposing* and the *exciting*. The most common *predisposing* cause seems to be bad air. Hence the great prevalence of the disease in ill-ventilated hospitals, and to a less extent even in those whose ventilation and other arrangements are as good as our present knowledge enables us to make them.[1] Habitual intemperance, bad diet, visceral disease—especially, as it appears, disease of the kidneys—are all undoubted predisposing causes. And many people, without any such definite predisposing causes, have a constitutional predisposition to erysipelas (particularly of the head and face), which will show itself in them on the slightest exciting cause, or even with no obvious cause whatever.

The *exciting* cause of erysipelas is very commonly a wound, and it is especially common after lacerated wounds of the lower extremities and scalp, in the latter case very often in the phlegmonous form (see INJURIES OF THE HEAD).[2] It is very liable to occur after puncturing or scarifying dropsical parts. A current of cold air on the head, cold to the loins during menstruation, any sudden chill, over-exertion or errors in diet, will sometimes be followed by an attack of erysipelas in those predisposed to it. There are also causes which are sometimes classed separately as *efficient* causes, inasmuch as they are looked on as really producing the disease, while the others only prepare the system for it. Such are poisoned states of the atmosphere, of the precise nature of which we are ignorant, but where, as is believed by some, germs are conveyed by the air which sow the disease, as it were, on wounds in persons predisposed to it, or where some material passes into the blood which excites the disease during its elimination. Many pathologists believe that the efficient cause of erysipelas is the contagion of bacteria, and their passage into the blood, and it seems at least certain that very frequently bacteria may be found both in the blood and in the tissues. They are found

Connection between bacteria and erysipelas.

[1] I cannot but protest against the assumption involved in the terms 'hospital erysipelas' and 'hospital diseases' as descriptive of the complications of wounds. Such complications are met with, it is true, most commonly in hospitals for the simple reason that wounds are also met with most commonly there; but they occur very frequently in private practice, even under the most favourable circumstances, and they have never really been *proved* to be relatively more frequent in good hospitals than in private practice, in similar cases. There is much need for us all to do our best to improve in every way the air, the treatment, the dressing, and all the other circumstances of the wounded in our hospitals—and thereby, doubtless, the prevalence of these complications will be lessened—but it is a sad error to impair the reputation, and thus diminish the usefulness, of our hospitals by reckless aspersions on their salubrity. See note (1) on p. 32 with respect to the prevalence of these diseases in St. Bartholomew's and St. George's Hospitals.

[2] But erysipelas when excited by a wound does not always attack the wounded part. I may mention a striking case. I amputated the foot of a man in perfectly good general health, on account of chronic disease of the tarsus, in the new hospital at Wimbledon. He was lodged by himself in an airy room which had never been occupied previously, but was quite dry, and in every respect most comfortable, well-ventilated, and overlooking a wide expanse of country. He had no visceral disease, and had never in his life suffered from erysipelas. There was no other patient in the hospital suffering from erysipelas, nor, in fact, any other grave case whatever, except one of amputation of the leg, performed on the same day. I had no patient under my care suffering from erysipelas. The two cases of amputation were in separate wards, attended by the same nurse, and dressed by the resident medical officer of the hospital. Contagion, therefore, seemed absolutely impossible, nor can I conceive a patient better circumstanced for recovery. The wound went on perfectly well, but erysipelas of the head, face, and chest occurred a few days after the operation, and proved rapidly fatal. I have seen many other cases in which a wound was the exciting cause; but, as the disease appeared in a remote part, we must seek elsewhere for the efficient cause. A very natural explanation (though hitherto conjectural only) would be that some morbid product is generated in the wound, and passes along the channels of absorption (veins or lymphatics) to the heart, and thence to the part affected.

also in the discharges, but this may be accounted for in various ways. A very interesting paper by Dr. Lukomsky, a pupil of von Recklinghausen, may be found in the sixteenth volume of Langenbeck's 'Archives,' in which it is sought to be proved (1) that bacteria may be found in the blood-vessels, the lymphatics, and the lymph-channels of the skin, the cellular tissue, and the internal organs in the human subject, when death takes place during the advance of an attack of erysipelas; (2) that the bacteria are no longer found in cases of death during the retrocession of the disease; (3) that an affection exactly similar to, if not identical with, cutaneous erysipelas can be excited in the lower animals, not only by the injection into the veins or under the skin of matter containing bacteria, but also by the application of such matter to a raw surface. If this should be confirmed it would afford an easy interpretation of the spontaneous, the traumatic, and the contagious origin of erysipelas; but a perusal of the debate at the Pathological Society, referred to on page 86, will show how very far we are at present from any trustworthy knowledge as to the universality and the significance of the presence of these minute organisms.[1]

Contagiousness of erysipelas.

Direct infection from putrefying discharges of any kind may produce erysipelas. Hence the prohibition of the use of sponges in hospital wards, since, after being infected by the discharge from one wound, they may be employed to cleanse another; and hence also the necessity for very great care in washing the hands after dressing each case before another patient is handled. It seems also undeniable that erysipelas has been propagated by contagion[2]—that is to say, that some material may be given off from the body of a patient suffering from erysipelas which will excite the disease in a person in health, and still more in a wounded or sick person—of course, supposing in either case a previous predisposition. Too numerous instances of this have been recorded by writers of experience and credit to leave any reasonable doubt that erysipelas is occasionally contagious. Yet, as patients are constantly received into our ordinary surgical and medical wards without any spread of the disease, its contagiousness must be very trifling, and in a well-ventilated and well-managed hospital there is no practical danger in so placing the patients, whilst the collecting of all the patients into special 'erysipelas wards' seems to concentrate the poison and increase the risk of contagion, unless such wards and all their attendants are absolutely separated from the rest of the hospital, which in practice it is very difficult to do.

Diagnosis and prognosis.

The *diagnosis* of the disease is usually obvious. In some few cases there may be a little difficulty in distinguishing diffuse inflammation from phlebitis or from inflamed absorbents, and I have seen a more fatal error committed in treating a case of deep-seated abscess below the fascia, accompanied by œdema and inflammation of the cellular tissue above it, as one of diffuse inflammation merely. The patient died, with numerous incisions into the subcutaneous tissue, but with the abscess unopened below; and I have seen the same error committed with less serious results, as the diagnosis has been corrected afterwards. When any reason exists for believing that matter is situated below the fascia, an exploratory puncture should not be neglected.

[1] The latest information on this subject will be found in Koch on 'Traumatic Infective Disease,' New Syd. Soc. Trans. 1880.

[2] In the above work it is asserted that Orth has produced in a rabbit 'an inflammation entirely analogous to erysipelas in man,' by subcutaneously injecting the fluid from an erysipelatous bulla, and propagated the disease to a second rabbit by inserting fluid from the œdematous cellular tissue of the first under the skin of the second.

The *prognosis* of the disease depends on a great number of different considerations. *Cæteris paribus*, the different forms of erysipelas are dangerous in proportion as they are deep-seated—the cutaneous, cellulo-cutaneous, and cellular in that order. But the prognosis varies also with the condition of the patient, being bad in the intemperate and bloated, and especially in those with diseased kidneys or liver; with the patient's age, being bad in the aged and in the *very* young, though good in childhood; with the exciting cause, being worse in epidemics; with the form of the disease, being worse in erratic erysipelas and in recurrent attacks; with its course, being worse when the disease does not subside at the usual period, and particularly if the fever is lighted up again after partial subsidence about the first week; with the situation, being worse in erysipelas of the head and face, and peculiarly so in diffuse inflammation of the neck, and especially if in either case the erysipelas spreads internally to the mouth and fauces. These are the main prognostic considerations, though many others might be added. And it should not be omitted that erysipelas is sometimes salutary, ushering in a better state of health, and preceding the definite healing of wounds and ulcers which had long been open and sluggish.

Treatment.

The *treatment* of erysipelas resolves itself naturally into *general* and *local*. The former is the same for all forms of the disease, and is regulated by the general symptoms present in each particular case, i.e. it consists in the treatment of the accompanying fever. In the present day the old antiphlogistic or depletory treatment of fever has been practically abandoned; yet there are cases of erysipelas in which, if I can trust my own observation, the indiscriminately stimulant treatment (which has so generally superseded that of indiscriminate depletion), is very ill-borne, and has a direct influence in prolonging the disease. The strength of the pulse, the general appearance of the patient, and his apparent vital power must guide the surgeon. In the plethoric and strong, after the bowels have been freely evacuated with a mercurial purge (which should be done in every case of erysipelas, even when diarrhœa is present, for the diarrhœa often depends on loaded bowels), salines with small doses of antimony, and light fluid diet without stimulants should be ordered. But there are very few cases (if any) which will not be benefited by the administration of wine or beer carefully at some period of the attack; and if there are any which require bleeding or leeching at first, I have not met with them, although I am prepared to admit the advisability of taking blood either from the arm, or better from the temples by leeches, in cases of erysipelas of the head accompanied by sthenic inflammation of the membranes of the brain. In almost all the cases of diffuse inflammation (cellulo-cutaneous) which we see after injuries, no judicious practitioner can hesitate as to the desirability of at any rate avoiding depletion, and a resort to free stimulation is generally followed by amendment. The diet must be regulated by the state of the appetite and tongue. It can do nothing but harm to load a man's stomach with food which he cannot digest, but when meat and other nourishing diet can be borne it should be given along with the stimulants. The kind and quantity of the latter must depend on the patient's previous habits to some extent, but nothing seems in general more grateful to the patient and more supporting than good porter. When there is much nervous excitement and restlessness opium should be carefully administered; but as a rule opiates are to be avoided in erysipelas, except in the phlegmonous form after injuries. Camphor, ammonia, and light tonics are generally well borne after the bowels have been regulated. Iron, particularly in the form of the Tinct. Ferri

Perchloridi, is undoubtedly useful in many cases, and it is believed by some surgeons to have a direct influence on the blood, and thus to act as a specific on the disease. This idea depends on an assumed condition of the blood in life something similar if not identical with the state in which the blood is found after death. There is no doubt that in many post-mortem examinations of persons dying with erysipelas nothing abnormal has been found except a thick, tarry, uncoagulated condition of the blood, staining the vessels, soon putrefying, and leading to a diffluent condition of the spleen and other viscera which contain much blood. On microscopic examination of the blood the corpuscles are found irregular and broken. It is assumed with great probability that this testifies to a previous disorganisation of the blood during life. And it may be that iron, if it can be assimilated, will correct this; and certainly the free exhibition of iron is very beneficial in many cases. But then it must be given very freely (say xv.–xx. drops every three hours) in order to produce any such specific effect. And it will not agree with the patient if given when the tongue is foul and the general fever is rising. When iron has been prescribed in such cases I have often seen marked benefit from discontinuing it, and prescribing salines, with small doses of antimony, if the strength admits of the latter drug being borne; or if there is much prostration, combined with tincture of bark and ammonia.

The local treatment differs according to the form of the disease. In the cutaneous form the exclusion of the air is often very soothing. Thus in erysipelas of the face a mask is made for the patient, smeared with some ointment (a favourite one for the purpose at St. George's Hospital is an equal mixture of Ung. Plumbi and Ung. Calaminæ), or the part is defended with a layer of cotton-wool, or some bland warm lotion is used, such as Lotio Plumbi, a lotion of sulphate of iron ʒj to Oj, or of the Tinct. Ferri Perchlor. ʒij to ℥viij of water. Diluted tincture of iodine is recommended by some. Nitrate of silver in a strong solution (about grs. xv. to the oz.) appears to me often very useful; and many surgeons are fond of drawing a ring round the erysipelatous rash, or round the limb above it, with a stick of caustic, a practice to which there is certainly no objection, though I cannot speak positively from my own experience of its utility.

In diffuse inflammation and in cellulitis more decisive measures are necessary. In the early stage, when there is only a little œdema around the wound, the discharge of inflammatory products is to be insured by laying the wound freely open with the finger or director. If, notwithstanding this, the inflammation spreads and the tension increases, it becomes a question whether or no incisions should be made, not in order to evacuate matter—for as yet no matter will have been formed—but to relieve the tension of the parts, and to avert the gangrene which is threatened, as well as to provide free exit for the matter when it does form. For there can be no doubt that the pressure caused by the exudation of serum and lymph on the capillaries which pass through the cellular tissue, and the stretching of these vessels as the skin is pushed away from the fascia, are potent causes of gangrene. When, therefore, the local symptoms are marked enough in the surgeon's judgment to require such severe measures, incisions ought to be made freely and boldly into the cellular tissue. Each incision should be of no great length (say two or three inches), but they should together embrace the whole extent of the tense parts; and if the tension affects fresh parts afterwards they should be repeated. A good proof of their necessity, and a good augury for their beneficial influence, is the free gaping of each cut as it is made. If any considerable vessel is wounded it must be

secured either by torsion or ligature, but a certain amount of bleeding is rather to be encouraged. If the hæmorrhage be alarming, but its source cannot be detected, in consequence of the cut vessel having retracted into the œdematous tissue, the bleeding can be repressed by stuffing the wound with lint for a few hours and making pressure over it. After four or six hours this may be withdrawn without fear of renewed bleeding.

In cases not severe enough to demand incision the parts should be relaxed with warm lotions or poultices. Many surgeons speak favourably of the apparently less severe measure of multiple punctures with a lancet as a substitute for incisions, but they generally give a good deal of pain, and are insufficient to afford relief.

In making the incisions it is often advisable to administer an anæsthetic, more especially in view of the very probable necessity of the repetition of the operation; and if the same indications call for it no hesitation should be felt in repeating the incisions again and again. I have often seen a case terminate happily with a dozen or more incisions, embracing every part of the limb, and have often seen occasion to regret that incisions had not been made freely enough where the patient has either sunk under the irritation of constantly advancing erysipelas, or has recovered, but with much loss of function of the limb from sloughing of skin, fascia, or tendons. In cases where this has unluckily occurred, leading to stiffness and loss of motion of the joints, and particularly the fingers, careful and diligent passive motion after the wounds are healed will often be rewarded with great success. The part should be well steamed, and each of the affected joints severally attended to, by gentle, cautious, and gradually increasing passive motion, while the patient is encouraged to use the part as much as he can, without great pain or subsequent swelling. Many unfortunate cases are sent into hospitals, in which the limb has been so disintegrated by the sloughing caused by neglected phlegmonous erysipelas that amputation is the only remedy.

Gangrene.

By *gangrene* is understood the death of a visible portion of the soft parts and its removal in a mass, which is called a *slough*. The terms *sphacelus* and *mortification* are also sometimes used to express the process of gangrene.[1]

Gangrene may be the result of mere spontaneous inflammation, but as a general rule this is not so. The great majority of the cases which we see in practice own some definite cause, although in most of them inflammation has played an important part in completing the death of the tissues.

Traumatic and spontaneous gangrene.

Gangrene is divided (*a*), according to its exciting causes, into traumatic and spontaneous, and (*b*) according to its form into moist and dry.

The usual causes which produce traumatic gangrene are mechanical injuries, chemical injuries, local poisons, heat or cold, and arrest of circulation.

The first cause is too familiar to need any illustration. Of chemical injuries the ordinary caustic issue is a common example, where the skin is destroyed by the dessicating action of the potassa fusa, and is cast off as a slough, the result being a healthy granulating ulcer. Closely analogous to such cases are those which result from the local action of poisons, such as putrefying urine. Such urine escaping through a ruptured urethra kills the cellular

[1] '*Gangrene* properly signifies the state which immediately precedes mortification, while the complete mortification, or absolute death, of a part is called *sphacelus*.'—Hooper's Med. Dict. But the distinction is not a very obvious one, and the term sphacelus is superfluous, and is now almost disused. When mortification is spoken of as distinct from gangrene, the former means the process, the latter the result.

tissue into which it is extravasated, producing secondarily the death of the skin which receives its nutrition through this cellular tissue. Gangrene from burns is unhappily only too common, and that from frostbite is tolerably familiar to most surgeons. Gangrene from arrest of circulation may arise from obliteration of the main artery at one spot, as when the femoral is tied, or from general pressure, as when the skin is destroyed by tight bandaging. Spontaneous gangrene occurs sometimes as the direct result of idiopathic inflammation, as the sloughing which follows a carbuncle; or it may be caused by degeneration of the vessels in old age (senile gangrene), by impaction of a plug of fibrine in a large vessel (gangrene from embolism), by inflammation of arteries leading to their obliteration, by loss of nervous power, and by impaired nutrition. The sloughing of the cornea which follows on injury of the fifth nerve is usually quoted as an illustration of gangrene produced by loss of nervous power, and the gangrene which used to be produced by eating cock-spurred rye, of gangrene from impaired nutrition; but the two causes seem identical, for loss of nervous power appears to produce gangrene merely by impairing the nutrition of the part. Gangrene is peculiarly liable to occur after slight injuries or other causes of inflammation in diabetic patients.

We see, then, one main distinction between the two classes of cases, which is of the highest importance in their surgical treatment, viz. that the causes of the former are local, and therefore often susceptible of mechanical removal; while those of the latter are mostly general; so that even if the affected part of the body could be removed without any injury to the patient, the same general cause would in all probability reproduce the gangrene elsewhere.

Moist and dry gangrene.

The division of gangrene into moist and dry is a classical, and in the extreme cases a very well-marked one, but in ordinary instances it is not very easy to refer the case to one or the other form. The best examples of dry gangrene are sometimes seen in the fingers or toes of very old persons, where the arteries become entirely impervious, the part turns dry and white (sometimes yellow or brown or black), shrivels up with little pain or inflammation, and thus separates from the body.[1] The purely inflammatory forms of gangrene, on the other hand, are always moist, much fluid and much gas, the result of putrefaction, are effused into the cellular tissue, and the affection is accompanied usually by a great deal of pain. So that it is clear enough that gangrene depends in the former class of cases on deficient supply, and in the latter on obstructed return of blood. But in most cases the two causes act together. Thus in senile gangrene the main cause is indisputably the deficient supply of blood, and it is therefore usually classed as a form of dry gangrene, yet obstruction of the capillary and venous circulation also plays a prominent part, and in many cases there is the inflammatory pain and the loading of the part with the products of inflammation which are characteristic of moist gangrene.

Phenomena of gangrene.

Taking an ordinary example of gangrene, in which the part has been previously inflamed, its red colour becomes livid or mottled, blebs or bullæ form, i.e. the cuticle separates from the cutis, and fluid, generally blood-tinged, is effused between them; the temperature of the part falls, it loses its sensibility, then the part turns black and decomposes, so that it crackles with em-

[1] This is sometimes called 'chronic' gangrene, as by Travers, who says: 'The main distinction between this and acute gangrene is, that from the first the part thus affected, losing its temperature and colour, becomes dry, tough, and shrunken, instead of moist, soft, and swollen, and takes on a yellow or blackish-brown colour, nearly resembling that of a mummy.' I have seen the colour in the fingers perfectly dead-white.

physema. If cut into it is found sodden with foul serum; in extreme cases all the tissues of the limb are softened and separated from the bone. This is *mortification*. The next step is *sloughing*—that is, the separation of the dead parts—a purely inflammatory process, exactly analogous to that by which a foreign body, such as a dart, if fixed in the living parts, is loosened and thrust out. The living (perhaps better called half-dead) tissues adjoining the gangrenous part become inflamed, and thus a red line is traced around the slough, which is called the *line of demarcation*, and the formation of which proves that the gangrene has stopped, at least at the part where the line is found. Next the inflamed parts suppurate, and thus a trench is dug around the dead part; granulations spring up and push off the slough, which is now loose and can be picked off. Very commonly one or two strings of cellular tissue resist longer the process of inflammation, and the slough requires to be cut away with a pair of scissors; and in the case of a limb the bone takes far longer to separate than the soft parts, and it is often necessary to divide it in order to rid the patient of the offensive putrefying mass. When the process of casting off the slough is completed the result is an ordinary granulating ulcer.

The general symptoms caused by an attack of gangrene are usually of a low or 'typhoid' character. The pulse is small, weak, and frequent, the tongue dry and brown, the appetite bad, and the strength failing. Death occurs from asthenia, and often very rapidly and unexpectedly.

Treatment. Amputation in traumatic gangrene.

In the treatment of gangrene the great question is, whether or no the part can be removed. Speaking generally this is only advisable in cases of traumatic gangrene, although in some of the more favourable examples of the spontaneous form it may be done after the line of demarcation has formed.

The first point is to distinguish between the cases which are purely *local*, and those in which the gangrene is of the *spreading* variety. The former are best exemplified by cases of sloughing of the leg after ligature of the femoral artery or rupture of the popliteal vessels. In such cases the patient often remains without any severe fever, the gangrene extends gradually, but never reaches above the point where the vessels have been tied or injured, and the surgeon may choose his own time for amputation. If the patient be quite healthy, there is no motive for delay—the limb should be removed at once; while, on the other hand, in cases of gangrene after ligature, where the patient has been in a feverish condition from the previous disease or its treatment, I have seen the best results from waiting till the constitutional excitement had subsided. But the treatment of the spreading form of traumatic gangrene is a matter of far greater difficulty. Here the gangrene propagates itself above the seat of injury,[1] and in many cases (as in the first of those related on the next page) will spread indefinitely, whether with or without amputation, till the patient dies. The cause of this rapid propagation seems to be, in most cases, a diffuse inflammation extending along the planes of cellular tissue or up the course of the absorbents or veins, and due, as we are taught by the followers of Mr. Lister, to the presence of septic organisms.[2] In other

[1] The process is thus graphically described by Mr. Holmes Coote:—'Nature endeavours to cast off the dead from the living tissues by an inflammatory process in the latter, which speedily lose their vitality from inability to support this action towards repair. According to Hunter, a diminution of power, when joined to an increased action, becomes a cause of mortification, by destroying the balance which ought to subsist between the power and action of every part. Thus the mortification spreads towards the trunk, preceded by a blush of dusky red, marking its onward course.'

[2] Without denying this, I would at least add that in many cases a predisposition to

cases, according to Mr. Cripps,[1] the spread of the gangrene is caused by blocking of the main veins in patients labouring under weakness or organic disease of the heart. In these latter cases, if we could distinguish them, there would be no motive for immediate amputation, since the surgeon could not hope to get above the limit of the thrombus in the vein, and if he did not do so, the gangrene would be sure to reappear in the stump. Such a cause might be suspected when, in a patient with feeble or diseased heart, gangrene spreads somewhat slowly up the limb without the usual signs of acute inflammation preceding it, and then the surgeon would be justified in waiting for the line of demarcation. In the gangrene produced by acute spreading inflammation, if the surgeon has the opportunity of amputating through a part of the limb which is not yet affected he should seize it at once. When the whole limb is implicated, so that amputation has to be done through inflamed tissues, the patient (as far as my experience goes) always either sinks at once, or is attacked with renewed gangrene in the stump, and so succumbs: yet the expectant treatment is usually equally fatal; so that most surgeons prefer the slight chance which amputation holds out. The usual error is to persevere too long in the vain attempt to save the limb. As soon as traumatic gangrene begins to spread rapidly, amputation should be at once performed through healthy parts; and then a large proportion of cases will recover. The not infrequent occurrence after injuries of this frightful form of spreading gangrene, accompanied as it is by such profound fever, shows that the surgeon has not accurately judged the nature of the injury at the time of its occurrence, or he would have amputated at once. Yet it must be admitted that the error is one which it is difficult to avoid. We are all desirous rather to save limbs than to amputate them. We can all look back on cases where the patient's obstinacy has triumphed over the surgeon's urgency, and has been justified by his preserving both life and limb. And it can hardly be doubted that formerly amputation was somewhat too frequently performed. We have lately had many cases published of the preservation of limbs (whether by 'antiseptic' dressing or otherwise) which would some years ago have been sacrificed; and in endeavouring to carry out such truly conservative surgery mistakes are inevitable. I will relate two cases. A man was brought to St. George's Hospital, of large frame, healthy appearance and history, who had sustained a severe injury to the elbow-joint. No case could seem more decidedly suitable for excision of the joint and preservation of the limb. I performed the operation with the sanction of my colleagues. The main nerves and vessels were perfectly intact. A day or two after the operation rapidly spreading gangrene attacked the fore-arm. One of my colleagues in my absence amputated the arm near the shoulder; gangrene rapidly attacked the stump, and death followed in a few days. The post-mortem appearances threw no light on the cause of this fatal tendency.

Another man, also of robust appearance, æt. 30, was admitted under my care from the country. A few days previously a charge of small-shot had lodged in the calf of each leg from a distance of about twelve paces. On admission there were found numerous shot-holes in both calves, with considerable bruising and swelling. On the third day gangrene of one leg had set in and spread rapidly. The patient when seen appeared to be sinking; and although there seemed little prospect of recovery, it was judged right to give him the small chance that amputation might afford him. He died, however, almost

unhealthy spreading inflammation is found in such cases, due to previously diseased states, especially chronic alcoholism.

[1] 'Syst. of Surg.' 3rd ed. i. 133.

immediately after the operation. On examination of the limb no artery of consequence was found wounded, nor was there very much extravasation of blood. In both these cases it is clear enough that primary amputation as soon as practicable after the accident would have given the patient the best chance for his life; but I do not know how the cases could have been distinguished from a multitude of similar injuries in which the limb has been preserved.

I allude to such cases in order to impress on the mind of the reader the vital importance of early interference where amputation is necessary, if the operation is to have a fair chance of preserving life. But if the attempt to save the limb has been made and gangrene sets in in a severe and rapidly-spreading form, it appears to be of little use to amputate—at least I have not seen any successful cases. And if the gangrene does not spread rapidly and is not accompanied by the severe constitutional symptoms which always accompany the acute form, it is questionable whether under ordinary circumstances amputation is necessary. The expectant treatment may succeed in preserving part or the whole of the limb.



FIG. 11. An embolic clot, lodged in and completely obstructing the superficial femoral artery just as it springs from the bifurcation of the common femoral trunk. The clot was irregularly adherent to the wall of the vessel, which had a slightly roughened appearance at the point of contact. Elsewhere the lining membrane was natural and the vessel quite empty. At the upper end, corresponding to the deep femoral (which was unobstructed), the clot was scooped out by the action of the blood passing into that artery. The patient was admitted with diseased heart and dropsy, and in the course of that disease gangrene of the foot supervened. The nature and seat of the obstruction could be quite easily recognised during life. Blocks of fibrine were found in the spleen and kidney.—St. George's Hospital Museum, Ser. vi., No. 199.

There are many other exceptions to the rule usually laid down, that amputation may be performed in traumatic gangrene. Thus in the gangrene which is caused either by heat or cold it is very rarely that amputation is successfully performed; for in burns the limb is generally scorched and partially disintegrated far beyond the part at which it is totally destroyed; and in frostbite, though the disintegration is less visible, yet it is so real, that in the Crimean campaign, where this injury was fatally prevalent, the surgeons at last gave up every form of operative interference, so uniform was the bad success—due no doubt in part to the general exhaustion of the patients, but partly also to the local effects of cold, extending beyond the frozen toes or fingers, and indisposing the tissues of which the stump is formed to take on reparative action. Gangrene from embolism might be thought to be a favourable case for amputation, and so it would be were it not for the concomitant heart-disease. In gangrene after ligature of the main artery we have perhaps the most appropriate example of the use of amputation in traumatic gangrene. Now, gangrene from embolism resembles this in many respects. The obstruction to the circulation is limited and definite; and the condition can frequently be diagnosed, as it was in the instance here figured; but as it is usually only a feature of a general disease

which is necessarily fatal, and which would usually preclude recovery from a serious operation, we hardly ever see amputation practised in such cases.[1]

On the whole, therefore, amputation on account of gangrene is more often practised before gangrene has set in, but when it is judged to be inevitable; and when amputation is performed later on, the successful cases are generally those in which the surgeon has waited until the process has stopped.

If the surgeon has decided to save the limb, or if the gangrene is in a part which cannot be removed, the first indication is to wrap it up as completely as possible in some application which will deodorise the dead parts and stimulate the living to cast them off. For the latter purpose uniform gentle heat is very desirable, and the two indications may be combined by a charcoal poultice; or some tarry preparation, such as carbolic acid or creasote, may be applied to the sloughing part, and the whole wrapped up in a thick layer of cotton-wool. Some of the balsams, such as Balsam of Peru or Friar's Balsam (Tr. Benzoin. Co.), poured into a poultice, or resinous substances, are also much in use. An old and very useful application is the 'green ointment' of the St. George's Hospital Pharmacopœia.[2] Many other local applications to gangrenous parts might be mentioned, but I think the principle of all of them is the same—to keep up the heat of the parts equal to or a little above the natural heat of the body; to stimulate the living parts and to deodorise the dead.

The general treatment of gangrene rests also on simple principles—difficult as it may be to apply them in practice—viz. to clear the alimentary canal and improve the digestion, so that the patient may be able to take such nutriment and stimulants as will keep him alive through the process; and to calm the nervous system and procure sleep by means of opium or some of its preparations, or, if these are not tolerated, by some other narcotic.

There are few cases of gangrene in which opium is not indicated, and this is especially the case the older the patient is; and there are perhaps none (at least none in which the gangrene is extensive enough to produce constitutional symptoms) where alcoholic stimulants are not required. But it is a great error to 'pour in' stimulants and narcotics without any reference to the condition of the tongue, pulse, and temperature. Narcotics are used chiefly to calm the patient and to avoid the exhaustion which excitement and pain produce; but opium when ill-borne will often make the patient semi-delirious, and will cause excitement and loathing for food, and so increase the exhaustion. In such cases the narcotic must be used cautiously and administered hypodermically or by the rectum, for many patients can tolerate morphia or opium in this manner who cannot take it by the stomach. But in some persons all opiates disagree, in whatever form or in whatever way they are given. Chloral, in full doses (say ℈j), should be tried in such persons, or hyoscyamus, or Indian hemp in doses of gr. i–ij. of the extract or ♏x–xx. of the tincture, cautiously increased if it seems to agree. But no narcotic is nearly so certain as opium or morphia; and this is usually not merely tolerated in cases of gangrene,

[1] A case of amputation for gangrene, the result of embolism, is reported in the 'Gaz. des Hôp.,' July 10, 1877. The stump was attacked with gangrene, and the patient died. Mr. Cripps gives an interesting example of successful amputation for gangrene the result of embolism in scarlet fever (op. cit. p. 123).

[2] The formula for this is—℞ Ung. Elemi, lb. j, Ung. Sambuci, ℥ iij., Bals. Copaib. ℥ iij. The ointments to be melted together and the Copaiba added to them after they have been removed from the fire, before they cool.

Ung. Sambuci is made with the fresh leaves of the elder (lb. ij), prepared lard (lb. ij ss.), and as much water as required.

but the patient's general condition improves under its use, visibly and at once. Stimulants are used to procure sleep, to assist appetite, to steady the pulse, and to lower the temperature; but they will not do this unless they are digested. The judicious use of purgatives and the apportionment of the needful stimulant, both as to quantity and quality, to the patient's powers of digestion, will tax all the experience and resources of the surgeon, especially when the patient is somewhat advanced in life and has already ruined his digestion and health by the abuse of fermented liquors.

It remains to speak of some of the special forms of gangrene.

Special forms.

Traumatic gangrene.

Enough perhaps has already been said about *traumatic gangrene* as far as concerns the question of amputation. It may be useful just to remind the reader that the limb may be hopelessly disorganised, both in military practice by spent shot, and in the injuries of civil life by extensive crushes, without the skin being very much injured; the soft parts are separated from the bone, the pulse in the main vessels is stopped, and an attentive examination will leave no doubt of the necessity for amputation. I ought also to add that the indications for the removal of the limb are quite different in early and in late life. Injuries which after middle life call imperatively for amputation may in childhood or about the age of puberty be most reasonably treated on the expectant plan, the surgeon feeling confident that if gangrene sets in and amputation becomes necessary there will be no such profound traumatic fever as that which, in later life, almost precludes the hope of success.

Bedsores.

A form of gangrene which may be regarded as to a certain extent traumatic is that from pressure—*bedsores*, or 'gangræna ex decubitu.' They are usually found in debilitated and emaciated persons who have lain long in bed and whose weakness prevents them from shifting their position often or much. They form usually on the sacrum, buttock, hips, and heels. The skin begins to look red and thin, and then a circular black slough forms. The parts may slough so deeply as to open the vertebral canal, and the sloughing is often the proximate cause of death in cases which might otherwise get well. Hence the greatest care should be exercised in all chronic cases to watch the state of the part on which bedsores usually form, and no doubt careful and dexterous nursing will prevent their formation in many cases, though it is most unjust and untrue to say, as is sometimes said, that the occurrence of bedsores proves careless nursing. In order to obviate their formation the first thing is to contrive frequent slight changes in the patient's position, to pad the parts where the bones press on the skin with air or water pillows, elephant-plaster cut into a ring, or some such contrivance, and to harden the skin by painting it with camphorated spirit or weak solution of nitrate of silver. If the redness still persists a soft poultice is, I think, the best application; and when gangrene is absolutely declared it must be treated locally, like any other form of sloughing.

A kind of bedsore is formed in fracture of the spine in which the sloughing is partly produced by loss of nervous influence. This will be spoken of under the head of INJURIES OF THE BACK. Sloughs somewhat similar to these also form spontaneously, or on parts exposed to slight pressure, in any acute disease of the great nervous centres.

The sloughing which is caused by tight bandaging is an illustration of gangrene from pressure with which we are happily unfamiliar in these days of improved medical education. Occasionally the formation of a small limited slough can hardly be avoided, but the mortification of the whole or great part of the skin of a limb is justly regarded as a proof of criminal negligence, and

punished accordingly. In the unhappy cases where this has occurred amputation is often necessary.

Frostbite. In *frostbite* the symptoms seen immediately after the injury are usually rather in excess of the real amount of destruction. Parts are cold, white, destitute of sensation and circulation, and seem condemned to inevitable death, which really will recover if they are patiently and gradually restored to the natural warmth. This is best done by rubbing the part gently with oil or with snow, and bringing the patient by degrees into a warmer atmosphere. If the circulation be too abruptly stimulated the frozen parts will probably slough. On the other hand, some time afterwards, the apparent is less than the real injury, since the parts which appear to be perfectly nourished are really incapable of sustaining the reparative process, and if operations be performed through them renewed sloughing or tedious ulceration will ensue. In the cases where gangrene sets in immediately it is of the dry form; the parts shrivel up at once, and never regain the warmth or colour of life. In other cases they perish from low inflammation, being unable to support the reaction which ensues on the return of the circulation. The treatment of frostbite, beyond the means required to restore warmth at first, involves no peculiarity except that the affected parts should long be kept warmly wrapped in wool.

Hospital gangrene. *Hospital gangrene* is an extreme form of sloughing phagedæna. The term 'phagedæna' has been applied to a combination of ulceration and gangrene in which as the ulcer spreads its surface sloughs more or less deeply. Two forms of this affection are recognised, viz. *spreading* phagedæna, where ulceration is the prominent symptom, the sloughing being only superficial, and *sloughing* phagedæna, where the slough which forms on the surface of the ulcer is thick, black, and round in shape, and appears to involve a considerable depth of tissue, so that the sloughing is the prominent symptom; but underneath this slough ulceration is going on, and these ulcerating tissues will themselves rapidly perish.

The disease which has been described to us by military surgeons[1] as 'hospital gangrene,' and of which we have been fortunate enough not to have seen any instances in the hospitals of this country,[2] is a severe form of sloughing phagedæna, accompanied by a constitutional affection which is usually, in fact almost always, fatal. Its cause appears to be general—i.e. to be contained in the atmosphere of the chamber in which it originates—and this seems to be usually the result of overcrowding, deficient ventilation, and uncleanliness acting on men depressed by wounds and possibly by defeat. The condition of the general atmosphere of the place may favour its development, but cannot induce it, for it is almost always observed that scattering the sick about the neighbourhood—even putting them into the open air under canvas—stops the outbreak. Direct contagion, there can be little doubt, acts powerfully as an exciting cause, and very probably the flies which generally abound in such places convey the poison from one wound to another.[3] From this contagious

[1] As, for example, in Hennen's 'Military Surgery,' from the outbreaks of this disease during the Peninsular War; or Macleod's 'Surgery of the Crimean War.'

[2] In South's 'Chelius,' i. 68, may be seen an account by Lister of a severe outbreak of sloughing phagedæna in University College Hospital in the year 1841, which attacked a large number of patients simultaneously, and which he classed as 'hospital gangrene,' but no case proved fatal.

[3] Many surgeons now regard this acute contagious gangrene as essentially identical with 'diphtheria of wounds.' I will here introduce Dr. Bristowe's description of the appearances of diphtheria when it attacks 'excoriated or raw cutaneous surfaces.' 'The redness of the

property, of which many striking examples are given, the disease is sometimes denominated 'Gangræna contagiosa.'

The disease commences with pain and tightness across the forehead, small, quick pulse, anxious countenance, stinging pain in the wound, swelling and hardness around its edges. The discharge becomes thin, gleety, and blood-tinged, with masses like gruel suspended in it. In a few hours the limb becomes greatly swollen, with blue congested veins—if cut into, the cut edges look like raw pork, from the œdematous condition of all the parts. The wound assumes a circular form, and is covered with a thick black slough, or its surface turns white or ashy-grey. The affection is attended by constitutional or traumatic fever in its severest form, from which the patient often sinks in a few hours, and which in general goes on to a fatal termination. The awful mortality attending on this disease is attested by many sad histories of overcrowded military hospitals and transport-ships, as in an instance recorded by Mr. Holmes Coote of a French Crimean transport, from which sixty dead bodies were thrown overboard in a passage of thirty-eight hours.

When this formidable disease has invaded a hospital there seems no question that the first thing which should be done is to empty the building of all the sick and wounded which it contains, isolating them if possible; and if that is not possible, putting them under canvas in the open air. The most minute attention must also be paid to the cleanliness of the dressings—every material with which the wounds are touched being burnt at once;[1] the gangrenous surfaces should also be covered over with thick layers of charcoal, creasote, carbolic acid, or some other disinfectant, so that there can be no possibility of the conveyance of matter from one sore to another. The sloughing surfaces should be destroyed by means of an active caustic, of which, perhaps, fuming nitric acid is the best; opium should be freely given and the patient's strength supported by liberal quantities of nutriment and stimulants. The cauterisation should be repeated as often as may be judged necessary, the patient being under anæsthesia.

Phagedæna.

The disease to which the name of hospital gangrene has been given—I think erroneously—and which has been seen of late years occasionally in our London hospitals, differs from the formidable affection above described in the essential particulars that little or no constitutional fever accompanies it, and that it involves very little danger to life. I make bold also to say that it differs in another respect, viz. that it has not been proved to originate from any hospital influence. We have had several outbreaks of this disease at St. George's Hospital, and have always found that it has been prevailing at the same time in the neighbourhood of the hospital, and has attacked persons who have had no connection whatever with the latter, so that the influences, whatever they were, which generated the disease could not have been confined to the hospital. It is, of course, theoretically possible that dirt and overcrowding

affected part is more or less vivid and intense, especially in a narrow zone, circumscribing the adherent pellicle; the pellicle is white, buff, grey, or black, not unfrequently looking like an eschar, and adherent to the surface; and (when the skin is the part involved) its extension is attended with the formation of vesicles at the margins, which run together, and lead to the development of spreading excoriations which presently get clothed with the enlarging pellicle.'—'Theory and Practice of Medicine,' 3rd ed. p. 194. I need hardly add that in all these destructive forms of inflammation micro-organisms are found, and are now very generally regarded as the agents of contagion both to adjacent tissues and to the blood.

[1] It is not enough merely to scald or boil sponges. Mr. Coote relates that in an outbreak of phagedæna in St. Bartholomew's Hospital the extension of the disease in two instances was clearly traced to the use of a sponge which had first been applied to a gangrenous sore, then boiled, and afterwards applied to a healthy wound.

might have generated the gangrenous affection both in private houses and in the hospital simultaneously. All that I can say is, that the efforts of numerous skilled enquirers, most ardently interested in discovering any such cause acting in the hospital, have hitherto failed entirely to detect it, and it seems to me both incorrect as a matter of science and unfair (I had almost used a stronger word) to call it by a name which implies that there is some proved and admitted unhealthiness in our hospital wards, when no such thing has ever been shown to be true. I prefer, therefore, to denominate this affection simply Phagedæna, and to confess that though there is a good deal of reason to suspect that it owes its origin, at least very frequently, to carelessness in hospital management, and particularly in the matters used for dressing wounds, yet that in very many cases it has been found hitherto impossible to verify this suspicion, and therefore impossible to explain the causation of the disease.

It occurs in two forms: the *sloughing phagedæna*, the severer forms of which approach the local character of hospital gangrene, and which are characterised by the round black slough and its thickened border; and the *spreading phagedæna*, in which the wound spreads with an irregular edge and a foul, sloughy surface. The depth of this sloughing from the surface of the ulcer is hardly ever considerable, though sometimes from the swelling in and around the sore it appears so. In the limbs it seldom extends below the deep fascia, though I have known it to do so, and for the same reason hæmorrhage is very rare.[1]

Mr. Pick[2] has noticed an interesting fact, which is sometimes to be observed in phagedæna, viz. that the pain of the wound ceases about twenty-four hours before the commencement of the sloughing, and that, coincident with this cessation of pain, there is a well-marked and very striking fall of the thermometer. The traumatic fever is usually high in cases which are attacked by phagedæna, so that the temperature will probably have ranged up to 105° or 106° F. From this there will be a sudden fall down to, or even below, 98°, and twenty-four hours afterwards the phagedæna will show itself. From these phenomena Mr. Pick has been able to prognosticate the occurrence of phagedæna in a case of amputation, where the surgeon in attendance was perfectly satisfied that the wound was going on quite well. But this phenomenon is not a constant one, nor is its cause obvious.

The pain in phagedæna varies much. Sometimes wounds may spread to a very considerable extent with but little suffering, at others very large doses of opium are required to quell the pain.

The treatment of phagedæna should, I think, be mainly local; the surgeon should endeavour to procure a more healthy surface to the wound, by applications of which energetic caustics appear to me the best. If the subject be young and healthy, steeping the affected surface in nitric acid, the patient being under chloroform, almost always stops the phagedæna. If this should fail, or if the surgeon be unwilling to employ so strong a measure, the sore must be dressed with some detergent and stimulating application, such as those used in other forms of gangrene (see page 52). Mr. Hutchinson has lately introduced into practice a painless, and as it seems very efficacious method of treating phagedæna, viz. by continuous immersion in hot water. The phagedænic

[1] It is well, perhaps, to point out that this remark does not apply to cases in which (as in sloughing after bubo affecting the deep-seated glands) the fascia may have been perforated before the phagedæna set in. In such cases the vessels are often exposed and occasionally give way.

[2] 'St. George's Hospital Reports,' vol. iii. p. 81.

part is immersed for about eight hours at a time in a bath of the temperature of 95° to 98°. After two or three sittings the sore has usually assumed a healthy appearance. Mr. Cripps says that this plan has been followed with extraordinary success in the venereal wards of St. Bartholomew's Hospital.

With regard to internal treatment, some persons believe that opium exerts a specific influence on the spread of phagedæna. Having had a large experience of opium so given, I am convinced that it has no such influence. Opium is very useful, indeed necessary, in such doses as are required to procure sleep and allay pain, and its good effects are indisputable in elderly persons of broken health and dissipated habits; but if given, as I have seen it, in enormous quantities frequently repeated, it seems to me to do harm, and I have seen phagedæna go on while the patient was being poisoned by opium —indeed, in one case up to the patient's death from the latter cause merely. If this man had not been treated at all I have no doubt that he would have got well. Such gross instances of malpraxis are, no doubt, rare, but I have equally little doubt that the error of giving opium beyond what is necessary under the idea that it is a specific in sloughing, is common. There are many cases which do well with no opium at all. It is always well, I think, to evacuate the bowels, and stimulants with nourishing food are usually indicated. Bark, quinine, and ammonia also seem to accelerate convalescence.

Senile gangrene.

Senile gangrene is the indirect result of the ossification or atheromatous condition of the arteries common in old age. It occurs in two forms, the dry and the moist. In the former the disease is purely one of obstructed blood-supply, and the arteries will sometimes be found filled with clot for a very considerable distance. Billroth points out that in senile gangrene it is not merely the anatomical condition of the arterial wall that is in fault, but that there is frequently also disease of the heart, and a tendency to embolism or arterial thrombus, so that the gradual spread of obstruction up the tube of the main artery can be verified by examination during life. Cases of spontaneous gangrene are on record at all periods of life, even in childhood, though but rarely, and usually after acute blood-diseases, as fever. But it will be sufficient to describe here the two forms of senile gangrene, leaving the rare cases of spontaneous gangrene at other ages to be dealt with on the same principles. The purely dry form, which in my own experience has been decidedly the exception, is the result of mere obstruction; the toes (in some very rare cases the fingers) turn black and shrivel, usually without much pain or constitutional disturbance; then a line of demarcation forms, and the patient may recover. In rarer cases a finger may simply shrivel up, without any discolouration. In the other form there is considerable pain and much redness around the black parts, together with œdematous swelling of the part, and all the evidences of inflammation; and it is clear that the gangrene is partly inflammatory, being caused probably by some irritation making a call on the powers of the part which the deficiency of its circulation renders it unable to supply. In many instances the outbreak of the disease is referred with great probability to some trifling injury, often a cut received in cutting the toe-nails. This form tends far less to limitation and therefore to recovery than the dry form. The disease is far more common in the male than in the female sex, and appears often to depend partly on visceral degeneration, the result of over-feeding, and which is frequently marked also by a gouty tendency.

In the treatment of senile gangrene the first point is to support the patient's strength, and the second to support the warmth of the part, in hopes that the gangrene may stop. Opium must be given to allay pain, and it seems always

might have generated the gangrenous affection both in private houses and in the hospital simultaneously. All that I can say is, that the efforts of numerous skilled enquirers, most ardently interested in discovering any such cause acting in the hospital, have hitherto failed entirely to detect it, and it seems to me both incorrect as a matter of science and unfair (I had almost used a stronger word) to call it by a name which implies that there is some proved and admitted unhealthiness in our hospital wards, when no such thing has ever been shown to be true. I prefer, therefore, to denominate this affection simply Phagedæna, and to confess that though there is a good deal of reason to suspect that it owes its origin, at least very frequently, to carelessness in hospital management, and particularly in the matters used for dressing wounds, yet that in very many cases it has been found hitherto impossible to verify this suspicion, and therefore impossible to explain the causation of the disease.

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or acute cellulitis, with reproduction of the mobile bodies in the blood. These bodies he considered to be analogous to amœbæ rather than bacteria.[1]

The treatment of these diseases is similar to that of other forms of gangrene, but here it is still more essential to destroy the sloughing parts completely, which is best done, I think, by soaking them with strong nitric acid. The French surgeons, however, prefer the actual cautery. Chloroform must be administered, the cheek thoroughly exposed, and the acid applied slowly and carefully to every part of the sloughing surface. When the disease does not commence in the mouth it is most important to stop its spread before it has extended into that cavity.

Free stimulation with wine is almost always necessary, and the exhibition of tonics with diffusible stimulants. Chlorate of potash enjoys a great reputation, and may be given in any dose up to a scruple; but I cannot say that I am convinced of its efficacy, and should be sorry to trust to it without the other and more powerful means of treatment.

Tetanus; its varieties.

Tetanus is defined as 'a tonic spasm of the voluntary muscles, with exacerbations;' that is to say, the muscles affected are in a constant condition of spasmodic tension, and this is exaggerated from time to time into violent convulsive action.

Tetanus is divided into traumatic and spontaneous. In this country it is almost always caused by an injury, and the most various, and sometimes the most trivial, injuries have been known to cause it; but it occurs spontaneously even in this country, though rarely, and more commonly in the tropics.[2] Tetanus is also divided, according to its course, into acute, sub-acute, and chronic, and varieties of the disease are named from the muscles implicated, viz. trismus or lockjaw, when the muscles around the jaw are alone or chiefly affected; ophisthotonos, when (as not uncommonly occurs in the spasms of acute tetanus) the muscles of the back draw the patient's body into the form of a bow, the body resting on the head and heels; emprosthotonos, when the abdominal muscles bend the body in the opposite direction; and pleurosthotonos, when it is bent to one side. The two latter are very rare; at least in this country. I have never spoken to anyone who has seen an example of either. Trismus exists more or less at the commencement of all attacks of acute traumatic tetanus.[3]

Symptoms of tetanus.

The *symptoms* of tetanus are usually as follows: At any period after the receipt of an injury or after a surgical operation, with no especial premonition, the patient begins to complain of an uneasy feeling of stiffness about the neck and lower jaw—'stiff neck,' as he probably terms it. After this there is difficulty in swallowing and chewing, and then complete fixedness of the jaws, the masseters and muscles about the upper part of the neck being felt firmly contracted. There is also commonly at an early period pain in the epigastrium, referred to affection of the diaphragm. Convulsive cramps now occur at any attempt to open the jaws or to swallow. There are sudden and violent cramps in the region of the diaphragm. The muscles of the abdomen and then those of nearly all the body are rigidly contracted, so that the abdomen feels like a

[1] 'Med.-Chir. Trans.' vol. lxi. p. 1.

[2] The spontaneous origin of the disease should not be admitted in any given case without enquiry. I have known a case regarded as spontaneous in which after death a wound was found which the patient had forgotten.

[3] See Sir B. Brodie's evidence on Palmer's trial in the newspapers of the time, or Dr. A. S. Taylor's paper in 'Guy's Hospital Reports' for 1856, pp. 296, 297.

to be well borne ; the part must be wrapped in cotton-wool and well deodorised. Amputation as a rule is to be deprecated, and the few cases in which it has been successfully practised afford to my mind no argument against this rule, since we know that recoveries also occur without amputation. Possibly there may be exceptions in cases where the surgeon can clearly detect the limit of the arterial affection ; but such cases must be very rare, and the few amputations which I have seen practised for senile gangrene have not predisposed me in favour of the idea.

There are two forms of gangrene which, singularly enough, are peculiar to childhood, viz. cancrum oris and noma vulvæ. The two names have been confused, since some surgeons call cancrum oris also by the name of noma, but it seems to me better to keep the terms separate.

Cancrum oris and noma.

The former, cancrum oris, is a very formidable disease in its worst forms. It is due to some profound exhaustion of the whole system, and usually follows on one of the eruptive fevers (measles most commonly) in children who have previously been ill-fed, ill-nourished, and brought up in bad air—at least, I am not aware that it occurs in others—and in these it does sometimes, though not often, occur without any feverish attack acting as a predisposing cause. The cheek swells, turns red and hard, and then a black spot shows itself either on the cheek or on the gums ; ulceration takes place, the gangrene extends itself to a variable distance in the soft parts, the breath becomes horribly foul, the gums are exposed, the bone crumbles away, and the teeth drop out. The child is usually very feverish and depressed. Death is very common, though not universal, even in severe cases.

Noma vulvæ is a similar affection of the external organs of generation in little girls ; sometimes it seems to be merely the result of dirt and neglect, and then usually more curable ; at other times it is caused by the same general constitutional conditions as cancrum oris ; and in such cases is much more dangerous. It begins either on the mucous or cutaneous surface of the vulva, sometimes, indeed, at a distance from it in the skin of the groin. The ulceration speedily assumes the sloughing form of phagedæna, and occasionally extends to a considerable distance, so as to cause great loss of tissue, and in some cases greatly to narrow the opening of the vagina after recovery. This, however, seldom takes place ; more commonly after recovery the destruction is found to have been much more superficial than it seemed at first. Both in cancrum oris and in noma vulvæ death often takes place very unexpectedly, and without any post-mortem appearances to account for it. This has sometimes been explained in the case of the mouth-affection as being the result of poisoning from the imbibition of the foul gas generated by the gangrene, and it may sometimes be so ; but such explanation is not applicable to the case of noma.

The pathology of these diseases is obscure. The arteries are found obstructed around the gangrenous part, as they are in other forms of gangrene, and in cancrum oris pneumonia is an almost constant complication—at least is constantly found on post-mortem examination. The gangrene has consequently been regarded as due to embolism, the result of pneumonia. But this explanation seems sufficiently refuted by the fact that the pneumonia is not generally present at the onset of the disease, as well as by the consideration that a central cause, such as pneumonia, is hardly consistent with such decided localisation of the gangrene, which is hardly ever seen except in the cheek or the vulva. Dr. Sansom, in an interesting communication to the Royal Medical and Chirurgical Society, described certain mobile bodies in the blood in a case of cancrum oris, the inoculation of which in lower animals produced death from peritonitis

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Tetanus; its varieties.

Tetanus is defined as 'a tonic spasm of the voluntary muscles, with exacerbations;' that is to say, the muscles affected are in a constant condition of spasmodic tension, and this is exaggerated from time to time into violent convulsive action.

Tetanus is divided into traumatic and spontaneous. In this country it is almost always caused by an injury, and the most various, and sometimes the most trivial, injuries have been known to cause it; but it occurs spontaneously even in this country, though rarely, and more commonly in the tropics.[2] Tetanus is also divided, according to its course, into acute, sub-acute, and chronic, and varieties of the disease are named from the muscles implicated, viz. trismus or lockjaw, when the muscles around the jaw are alone or chiefly affected; ophisthotonos, when (as not uncommonly occurs in the spasms of acute tetanus) the muscles of the back draw the patient's body into the form of a bow, the body resting on the head and heels; emprosthotonos, when the abdominal muscles bend the body in the opposite direction; and pleurosthotonos, when it is bent to one side. The two latter are very rare; at least in this country. I have never spoken to anyone who has seen an example of either. Trismus exists more or less at the commencement of all attacks of acute traumatic tetanus.[3]

Symptoms of tetanus.

The *symptoms* of tetanus are usually as follows: At any period after the receipt of an injury or after a surgical operation, with no especial premonition, the patient begins to complain of an uneasy feeling of stiffness about the neck and lower jaw—'stiff neck,' as he probably terms it. After this there is difficulty in swallowing and chewing, and then complete fixedness of the jaws, the masseters and muscles about the upper part of the neck being felt firmly contracted. There is also commonly at an early period pain in the epigastrium, referred to affection of the diaphragm. Convulsive cramps now occur at any attempt to open the jaws or to swallow. There are sudden and violent cramps in the region of the diaphragm. The muscles of the abdomen and then those of nearly all the body are rigidly contracted, so that the abdomen feels like a

[1] 'Med.-Chir. Trans.' vol. lxi. p. 1.

[2] The spontaneous origin of the disease should not be admitted in any given case without enquiry. I have known a case regarded as spontaneous in which after death a wound was found which the patient had forgotten.

[3] See Sir B. Brodie's evidence on Palmer's trial in the newspapers of the time, or Dr. A. S. Taylor's paper in 'Guy's Hospital Reports' for 1856, pp. 296, 297.

board, and on handling the limbs they may be as stiff as in death, but the muscles of the wrists and fingers are usually exempt from spasm. The contraction of the facial muscles gives a sardonic grin to the features, 'the tetanic grin.' The tetanic state is now fully established. The pulse is usually unaffected, except during the spasms, when it is quickened. In the acutest cases, however, there is often great general fever, as the thermograph from a rapidly fatal case, on page 63, will show. The bowels are generally constipated and the motions scybalous. The spasms vary much in severity. They are sometimes so severe as to jerk the patient out of bed, and even to rupture the muscles.[1] Occasionally the tongue is protruded from the mouth, and, being caught by the closing jaws, is severely lacerated. The spasms are liable to be brought on by any sudden impression—a noise, the slamming of a door, a draught of air. Sleep is rare and short in acute cases. The contraction of the muscles either ceases altogether or is greatly relaxed in sleep. The intellect is not affected. Death seems to be caused sometimes by spasm of the glottis; but usually occurs from suffocation during a spasm produced by the stiffness of the muscles of respiration, or from exhaustion.

All this applies to the acute form of the disease; the sub-acute and chronic differ from the acute only in the course and severity, not in the character or order of succession of the symptoms. Speaking generally, the later after the injury the symptoms come on, the more chronic is the course of the disease and therefore the greater chance is there of the patient's recovery.

There is a form of tetanus, called *trismus nascentium*, which affects infants in the first or second week of life, and which has been connected by some authors with the section of the umbilical cord. It is very fatal, though instances of recovery are not unknown. Generally, however, this infantile tetanus ends in death much more speedily than the adult disease. Tetanus has also been known to be caused by parturition.

Nothing, or next to nothing, is known as to the predisposing causes of tetanus. It is much more common in hot countries than in cold, and it attacks persons of the negro race much more commonly than whites. Bad hygienic conditions seem to favour its development, as malaria, and possibly bad ventilation.

The idiopathic form of the disease seems far more common in the tropics than in this country. It has been referred to various causes, of which the best authenticated seems to be the sudden suppression of perspiration by exposure to cold and damp; and it appears that a loaded state of the bowels is at any rate a predisposing, and it has been looked upon as an exciting cause, of idiopathic tetanus.

Diagnosis. Tetanus requires to be diagnosed from hysterical affections, from the convulsions produced by strychnia-poisoning, from epilepsy, and from hydrophobia. As above stated, the symptoms, in the early stage, are those of ordinary stiffneck (rheumatic affection of the muscles of the jaw and neck), but the progress of the case prevents any permanent confusion.

The diagnosis from hysteria is not always perfectly easy, and this will be evident from the simple consideration that tetanus may attack a hysterical person, and may be complicated with hysterical fits. But, ordinarily, hysterical lockjaw or any other tetanic symptom simulated by hysteria may be distinguished from the real disease by the patient's general condition and appearance, by the complete relaxation of the spasms from time to time, and by the fact that sooner or later the patient is sure to be able to eat.

[1] Most museums contain specimens of one of the long muscles ruptured in tetanus. Thus in St. George's Museum, Sec. iv. No. 1, is the rectus abdominis muscle torn across in a tetanic spasm.

From strychnia-poisoning the diagnosis may also for a time be very difficult, as the celebrated trial of the surgeon Palmer for the murder of a man named Cook by strychnia shows, in which many medical men swore that in their opinion the man died of tetanus, or of epilepsy with tetanic complications. But the same trial brought out very clearly the differences, viz., that the spasm from strychnia-poisoning commences and culminates with great rapidity, and without any previous stiffness about the jaws and neck; and that if the dose is insufficient to cause death the symptoms subside with equal rapidity, leaving the patient in perfect health, but for the exhaustion following the spasms; that there is nothing of the tonic spasm with convulsive exacerbations which characterises true tetanus. The spasms also of strychnia differ from those usually seen in tetanus in that they affect the muscles of the trunk and limbs only, and not the jaw, and that they affect the muscles of the wrists and fingers, which as above noted, are usually unaffected in tetanus. These minor differences, however, could hardly be alone relied on.

From hydrophobia the differences are these; in hydrophobia the spasms are clonic—that is, the jaw may be spasmodically closed, but it will drop into complete relaxation—which is not the case in tetanus. In tetanus there is no dread of water, no aversion to it, though the attempt to drink may cause spasm, as any other excitement may; the countenance in tetanus, though distorted, is calm, unlike the glowing eyes and excited face of hydrophobia; and the state of the mind corresponds, being calm and collected in tetanus, wild and often subject to delusions in hydrophobia.

From epilepsy there are numerous distinctions. Any case of epilepsy likely to be mistaken for tetanus will in all probability be accompanied by insensibility, which is never the case in tetanus, and by blueness of the surface. And then there is the great distinction that epileptic seizures have complete remissions, i.e. the spasms are clonic, while tetanic convulsions are connected together by the tonic spasm.

Pathology.

Nothing is really known of the pathology of tetanus. There have been cases in which a morbid condition of nerves has been found at the seat of the injury, and where the removal of the nerve so injured has been followed by immediate recovery. There have also been cases in which after death distinct evidence of inflammation of the trunk of the nerve has been found, extending to some distance, and others in which the spinal cord has been found inflamed. From which the inference has been drawn that the pathology of the disease consists essentially in inflammation propagated through the nerve or nerves injured to the spinal cord, thus exciting the general spasmodic condition. This explanation, though the most logical which has as yet been offered, is apparently contradicted by the anatomy of many cases in which the nerves have been found to all appearance healthy, and by the course of others, in which the injured part has been removed, with no benefit; though, doubtless, in the latter cases the ill-success might be explained by supposing that the morbid condition of the nervous centre was already generated; and in the former it may be said with much plausibility that morbid conditions really existing may have been overlooked, in consequence of the method of research not having been sufficiently delicate. Lockhart Clarke [1] has described alterations in the minute structure of the spinal cord in tetanus, which may very probably have existed in many cases where the cord was put down as 'healthy,' since such changes would not be detected by an ordinary naked-eye examination of the cord, such as is usually made. To the same effect are Dr. Dickinson's observations,[2] and

[1] 'Med.-Chir. Trans.' vol. xlviii.

[2] 'Med.-Chir. Trans.' vol. li.

other pathologists have published similar cases. It is unnecessary to describe these changes minutely. Accurate plates from Dr. Dickinson's preparations are to be found in his paper. Suffice it to say that they show inflammatory exudation and extravasation of blood in the white columns and softening of the central grey matter of the cord. Dr. Coats [1] has confirmed these observations and has figured similar changes in the medulla oblongata. But other investigators, of undoubted skill, have failed to find these changes; [2] and even allowing them to be constant, it would still remain a question whether they are the cause of the disease, or its consequence. However, if we do not regard the tetanic condition as being due to irritation of the spinal cord propagated to it through the injured nerves, we must take refuge in the vague theory 'that it results from poisoning with some peculiar substances which possibly are very rarely formed in wounds, and thence absorbed' (Billroth). Such a theory leaves our knowledge of the pathology and treatment of the disease just where it found it. But if we admit that the disease starts from irritation of the injured nerve, one practical conclusion of great importance would follow, viz. that

Treatment.

the part should be removed, or the nerve be excised, divided, or stretched at the first definite symptom of tetanus, and I must say that such a rule seems to me a good one. Mr. Bryant [3] mentions a case in which 'Mr. Key amputated a leg on account of tetanus, which had appeared six days after an unreduced dislocation of the astragalus. The symptoms disappeared at once after the operation. On dissecting the foot the posterior tibial nerve was found to have been put violently on the stretch by the projecting astragalus.' I have seen at least one similar case. That amputation usually fails, however, is quite true; and this we might expect, since the symptoms show that the irritation has already reached the central organ. Yet the chance that it may not have gone so far as not to be capable of recovery, if only the peripheral excitement is removed, justifies amputation, in my opinion, in appropriate cases. To be of any service it must be done early. The same end may possibly in some instances be effected by excision of a portion of the nerve, but it is rarely that the precise nerve can be isolated. Lately, both in France and England, tetanus has been treated by exposing and stretching the main nerves. Dr. Brown-Séquard ('Syst. of Surg.' 8rd. ed. ii. 219) says that he is acquainted with twenty-three cases of tetanus in which nerve-stretching has been employed, and that eight of these recovered, and that in some at least of these 'the symptoms were quite severe;' and he thinks that the plan is worthy of further trial, if used together with some powerful internal remedies. All the nerves going to the part should be stretched; the stretching should be strong enough to destroy the power of transmitting sensitive impressions, and should be done as far away from the wound as possible. The general subject of nerve-stretching will be found treated in a subsequent chapter.

Irrespective of these surgical measures the treatment of tetanus is entirely empirical, and completely unsuccessful. Possibly we ought to except from this sweeping condemnation the application of ice to the spine, which has, indeed, some logical basis, inasmuch as it seeks to reduce the temperature, and thus to combat the inflammation of the part whose irritation is believed to generate the disease, and in that sense may be said not to be empirical, but it seems

[1] 'Med.-Chir. Trans.,' vol. lxi. p. 79.

[2] Billroth says: 'Rokitansky states that he has found in the spinal cord a development of fresh connective tissue, from which it would appear as if we had to deal with an inflammatory process in this nerve-centre. My investigations of the spinal cord and nerves in tetanus have as yet given negative results only.'—'New Syd. Soc. Transl.' vol. ii. p. 69.

[3] 'Practice of Surgery,' 2nd ed. vol. i. p. 244.

entirely unsuccessful. Nearly every drug in the Pharmacopœia has been tried with occasional successes, but these successes have been obtained mainly in the subacute form of the disease. Acute tetanus, though not uniformly fatal, is very generally so, and the few patients who have survived appear to have recovered under quite different kinds of treatment. If life can be prolonged beyond the third week, recovery becomes probable, though instances of death up to the thirty-ninth day are recorded by Mr. Poland.[1] Therefore, in our present ignorance of the real pathology of the disease, and consequently of the effect of medicines on it, our great object is to keep the patient alive, till the time when, as experience teaches, the irritation may have worn out, and his powers may suffice to carry him through. Chloroform may be cautiously tried, and if it can be borne it will relax the spasms and permit the introduction of food into the stomach; but its exhibition often sets up an amount of spasm which threatens to prove fatal. Most patients can get enough fluid nourishment through the closed teeth to keep themselves alive, or they can be fed by a tube passed through the nostrils. If this is not the case life cannot be long supported by enemata, and under these circumstances I entertain no doubt that it is justifiable to induce anæsthesia at any risk in order to feed the patient. And in such circumstances the larynx may be opened, in order to obviate death from spasm while the patient is being narcotised. Also if death is threatened from spasm of the glottis tracheotomy may be performed. In one such case I saw much difficulty, from the neck being twisted, in keeping the incision near the middle line. Sleep is always to be procured by chloral or by morphia, which may be injected subcutaneously. The bowels ought, no doubt, to be unloaded at the commencement of the disease, and the purgation should be frequently repeated; the patient ought always to be kept in a cool, quiet, darkened room, and carefully defended from draughts and noises. As to the internal treatment, it is undoubtedly justifiable to use some of the medicines which have proved successful in other hands, or to try any new plan of treatment which affords a rational prospect of success. Of the former class, the administration of the tincture of aconite is, I think, on the whole the most promising. Five minims of the Pharmacopœia tincture may be administered in a small quantity of any convenient vehicle every two hours until some definite impression is produced on the pulse and temperature. In acute tetanus the temperature sometimes rises abruptly and continuously till the time of death, as in the case from which the annexed thermograph was taken;[2] and it is in these cases that large doses of

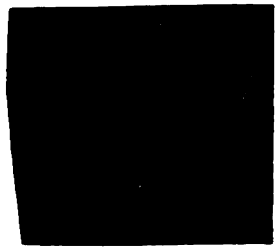


Fig. 12. Thermograph of Tetanus. From a case under my own care, which proved fatal 18½ hours after the first decided symptoms of the disease. The case is recorded in Dr. Dickinson's paper in 'Med.-Chir. Trans.' li., where the post-mortem appearances are described and figured.

[1] Out of 327 fatal cases, 79 died within 2 days.
104 „ in from 2 to 5 days.
90 „ „ 5 to 10 days.
43 „ „ 10 to 22 days.
11 „ beyond the 22nd day.
'Syst. of Surg.' 3rd ed. vol. i. p. 205.

[2] The fullest description with which I am acquainted of the changes of temperature in traumatic tetanus, will be found in 'Med. and Surg. Mem.' by Dr. Joseph Jones, New Orleans, 1876, vol. i. pp. 154 et seq., in which work numerous careful records of temperature are given, and the observations and opinions of all the authorities, ancient and modern, who have treated this subject are discussed. It seems clearly to result from what is known on the subject, that in cases of subacute and chronic tetanus the variations of temperature are

alcohol may be expected to prove advantageous; but the use of alcohol as a specific, the patient being kept in a state of constant intoxication or semi-intoxication, seems to me not only useless but injurious. It would be vain to enumerate all the specifics which have at various times been recommended. They have all obtained their reputation from their success in a few cases, which were in all probability of the subacute form—a form in which recovery is common under any treatment, or under no definite treatment, if the bowels be kept free and the patient's strength supported by such food as he can easily take and assimilate. Opium, chloral, Calabar-bean, nicotine, turpentine, camphor, quinine, strychnia, curara, are the chief among the many remedies which have obtained some reputation, and some of these substances have been injected into the veins, as chloral. I will only say that those medicines which tend to constipation (as opium) seem to be mischievous; those which are highly poisonous, as nicotine, curara, strychnia, appear to add a new danger to the disease, without any reasonable hope of benefit;[1] and the same appears to be true of intravenous injection. Quinine is, I have no doubt, completely inert; chloral, camphor, and turpentine are doubtless useful in subacute tetanus, and the first may afford some relief in the spasms of the acute disease; but none of these, nor, as far as I know, any other medicine, seems to have any curative virtue in acute tetanus.

Delirium tremens.

Delirium tremens, the delirious excitement which depends on chronic intoxication, is a disease which we have only too frequent opportunity of seeing in our hospital patients, both as a spontaneous affection (in which respect it falls within the care of the physician) and as a complication of surgical injury, in which latter respect alone I shall here speak of it.

The delirium which is excited in a patient labouring under chronic intoxication—that is to say, in one whose blood and tissues, especially those of the brain, are deteriorated by the too free use of alcohol—is marked by several peculiarities which distinguish it from the delirium of ordinary fever, as well as from any other form of aberration of mind. The main peculiarity of the delirium is its *busy* character, and the prevalence of one dominant idea which is generally distressing or alarming to the patient.[2] The delirium is not usually violent, and any person who is not afraid of the patient, and who can speak to him with authority, can generally control him. The next, and perhaps the most characteristic, feature of the disease is the *tremor* from which it takes its name, and which is generally seen in all the muscles, those of the tongue and face as well as the extremities, though it is most marked in the hands. Another and most painful symptom is the want of sleep, and indeed of any rest either of body or mind; and this sleeplessness will usually be found to precede the delirium. A restless, tremulous, feverish, half-rational condition commonly ushers in the defined attack of delirium. The general condition is also most unlike that of the delirium of either traumatic or any other fever. Traumatic fever may of course accompany the attack of delirium tremens in surgical cases, but apart from this there is little evidence of general fever. The temperature is not high,[3] the skin is usually bathed in a profuse

neither striking nor of any certain signification, but that a rapid and abrupt rise of temperature, such as is figured in the text, is usually a fatal indication. The temperature has been known to rise much higher than is here figured temperatures of 112° and 113° are said by Wunderlich to have been noted immediately before or after death.

[1] Mr. Hulke, however, thinks that the extract of physostigma (Calabar bean) hypodermically administered, in doses of ¼ gr., deserves further trial. 'Syst. of Surg.' 3rd ed. i. 209.

[2] See Haward, 'Syst. of Surg.' 3rd ed. vol. i. 212.

[3] I believe this is usually so in cases of ordinary severity, but in fatal cases the tempera-

sweat, the tongue, instead of being dry and brown, is moist, white, and œdematous, the pulse is small and quick, but not hard. There is almost always a loathing for food, and the patient often vomits. Evidences of visceral disease will often be discovered, especially in the kidneys and liver.

The treatment of delirium tremens used to be conducted on the antiphlogistic plan, the disease being confounded with inflammation of the brain, and this treatment was very fatal. In the reaction from this error it became usual to treat the disease with enormous quantities of stimulants and of opium; and I cannot but think that this treatment, if pursued on a merely routine plan, is also unsuccessful, i.e. that it aggravates instead of diminishing the danger of the disease, though not to so great a degree as the depleting plan. In fact, every case of delirium tremens should be treated on its own indications. In the premonitory stage, when the occurrence of tremor, with some restlessness, in a patient known or reasonably suspected to be of drunken habits, gives fair cause for believing that an attack of delirium tremens is imminent, it is only too common to ply the patient with more stimulants, probably on the principle contained in the old proverb, 'A hair of the dog that bit you.' No treatment can have less support from logic, nor do I think that experience lends it any support either. In patients of drunken habits admitted into the hospital I make it a rule to give them no more stimulant than to a healthy and sober person, to purge them freely, supplying them with a good supporting diet, and to procure sleep by the subcutaneous injection of morphia if necessary; and under this regimen the threatening symptoms almost uniformly disappear. When the delirium is fully developed the same line of treatment should be pursued. The chief indications are to soothe the patient as much as possible, to procure sleep, and to enable him to take food. For the first purpose it is most essential to use no mechanical restraint if it can be avoided. In public institutions, where separate rooms can be obtained for the treatment of the case, and the services of a number of men can be procured if required, it ought to be very rarely necessary to tie down a patient suffering from delirium tremens; and if unnecessary it cannot but be prejudicial to the case. In order to procure sleep opium or morphia must generally be given. The slighter cases may recover the power of sleep under free purging, as they regain that of taking food; but in almost all traumatic cases it is advisable to procure sleep at once, as the restlessness of the patient renders him liable to disturb the injured parts. Chloral with or without bromide of potassium may procure sleep in the slighter cases; but speaking generally the best agent for this purpose is morphia, which ought to be injected under the skin in a tolerably large dose (gr. ½), and repeated in about half an hour, if sleep is not obtained, and so on until the patient does go to sleep. Mr. Morrant Baker has shown how much the narcotic power of the morphia injection is increased by the simultaneous administration of chloroform;[1] and since reading his paper I have tried the plan with signal success in a very severe case, which without timely relief would probably have proved fatal. At the same time the bowels should be kept very freely open, and it may be necessary to give some tonic —quinine, ammonia, or bark with mineral acid.

The use of stimulants in delirium tremens will need all the care and all the experience of the surgeon. In most cases I believe some amount of stimulant

ture has been known to rise just before death as high as 108° F.—'N. Y. Arch. of Clin. Surg.' ii. 113.

[1] 'St. Barth.'s Hosp. Reports,' vol. xix. p. 249.

must be given, since the patient is weakened both by the shock of the injury and by the restlessness and agitation of the delirium, and cannot bear the deprivation of his accustomed drink. But I am in the habit of limiting that quantity as much as the state of the pulse permits while the patient remains unable to take food, and diminishing it rapidly as soon as nutrition can be procured otherwise. And when the patient is once out of serious danger I am quite sure that the enforcement of total abstinence is as good for his physical as for his moral health.

In other cases, as it seems to me, in which the symptoms are not urgent and the pulse is strong, there is no need for the administration of any stimulant or tonic ; but, on the contrary, along with the free administration of purgatives the cautious use of antimony seems to assist in getting rid of the poison and restoring the appetite. As to the alleged benefits to be derived from the administration of very large doses of digitalis, I have no experience. Generally when the patient can once be got to take food, and particularly solid food, with a relish, sleep will return and he will soon be well ; and, conversely, if sound sleep can be procured, generally the appetite will return and the case will do well. But this is only generally true. In some cases the patient will sink, although the insomnia has been conquered. A man was under my care with compound fracture of the leg in whom a severe attack of delirium tremens came on shortly after the injury. After two days of restlessness a sound and natural sleep of several hours was procured by the subcutaneous use of morphia. He awoke refreshed and free from any signs of the constitutional effect of opium, but soon began to sink, and died rapidly. Extensive disease of the liver and other viscera was the cause of death in this instance. And our prognosis in cases of delirium tremens must always be a cautious one, since latent visceral disease, such as fatty heart, may very possibly be present.

I would, however, again urge on the reader the great importance of avoiding over-narcotism or over-stimulation in this disease. Great as the virtue of opium and morphia is when judiciously employed, we must not forget that when not well borne they constantly produce delirium, and that a form of delirium tremens has sometimes been known to be produced by opium-eating. Nor can I see on what ground of reason or of therapeutical experience we can expect a cessation of the effect from a continuance of the very irritation which produced it. Yet this is exactly what is implied in the routine treatment of delirium tremens with stimulants. We find a patient who has soddened his brains with gin and beer, and probably has already suffered from previous attacks of delirium, and we think we shall cure him with more gin and beer.

CHAPTER III.

POISONED WOUNDS AND ANIMAL POISONS.

Poisoned wounds.

THE inflammatory complications which we have been studying hitherto attack wounds of all kinds, irrespective, as far as we know, of anything special in the nature of the injury; but there is a large class of wounds in which the inoculation of some definite poison produces symptoms more or less peculiar.

It would be endless to enumerate all the varieties of poison which may be conveyed into wounds, or all the various ways in which such conveyance may be effected. It will be enough for our present purpose to divide poisoned wounds into the three following kinds: (1) wounds inoculated with matters which produce only ordinary traumatic fever and its complications; (2) wounds inoculated with matters which produce symptoms of specific general poisoning; (3) wounds inoculated with matters which produce definite diseases. The first class of cases is only separated from those which have been described in the previous chapters by the fact that in these a *materies morbi* is known to have been inoculated, whilst in those nothing of the kind is known to have taken place, though there can be little doubt that in many instances the wound has really been poisoned at the time of its infliction, and in many of the cases of secondary complications (erysipelas, pyæmia, &c.) the symptoms are so exactly similar to those of poisoned wounds, as to leave no reasonable doubt that they depend on the imbibition into the blood of morbid poisons developed spontaneously in the wound, exactly similar to, if not identical with, those which are inoculated in cases of poisoned wound (see page 17). The first class of poisoned wounds is best illustrated by dissection-wounds—injuries which display the phenomena of such wounds in their most characteristic form, with the exact circumstances of which we are acquainted from the moment of their infliction, and with which few of us are not familiar from painful experience. The very same injuries are suffered, in the course of their business, by cooks, butchers, fishmongers, &c.; and similar symptoms may be elicited by inoculation with various other substances, both vegetable and mineral, though these, especially mineral matters, do not often occasion more than mere local inflammation.

Dissection-wounds.

The phenomena of dissection-wounds occur in an acute or chronic form. The former is perhaps the most formidable and the most rapidly fatal of all the forms of septicæmia. I have spoken of them as 'wounds,' but the inoculation may pass through the unbroken skin, and has done so in many recorded instances—notably that of Sir J. Paget.[1] It seems universally admitted that 'the most dangerous post-mortem examinations are those of women who have died with puerperal peritonitis; and that the inflammatory products of pyæmial disease are especially virulent after death.' They are also especially virulent before death. Thus, Sir J. Paget tells us that both his own nurse and the nurse of a friend of his who was suffering at the same time from dissection-wound had their fingers poisoned by the matter. The danger seems only present during life and for a short time after death; when advanced putrefaction comes on no such special poisonous property is observed. Wounds poisoned in the dissecting-room hardly ever develop more than the milder or chronic

[1] 'Clinical Lectures and Essays,' p. 322.

symptoms. The nature of the virus is not known, nor is it known what makes a man liable to it; but it seems as if an immunity could be acquired by constant exposure, exactly as one can be acclimatised to any other form of morbid influence. 'They who are day after day engaged in dissections or in post-mortem examination,' says Sir J. Paget, 'usually acquire a complete immunity from the worse influences of the virus. They may suffer local troubles from it, or they may lose health through the influence of bad air or over-work, but they do not suffer with any infection of the lymph or blood.' Though spoken of for convenience as dissection-wounds or dissection-poisons, the affection is one which may result also from the inoculation of matters from living bodies, as many cases show—notably that which deprived the profession some years ago of the rising talent of Mr. Maurice Collis, who died from inoculation received in an operation for the removal of a tumour of the jaw. Sir J. Paget has noticed a fact which, if it be confirmed by subsequent experience, will be of the highest importance, viz. that one attack serves to give an immunity for a considerable time from renewed infection, though this immunity is not permanent.

The most acute cases are well described in the words of Mr. Callender, quoted on page 80, as a description of septicæmia in its severest and most rapidly fatal form; and, as far as I know, the occurrence of such symptoms precludes all hope of recovery, though we must, of course, try to support the patient and relieve tension by timely incisions in any parts which may be inflamed. But frequently the fatal issue occurs before any local inflammation shows itself.

Happily, however, such cases are very rare. The only one which has lately occurred in this city was that which led to the lamented death of Dr. Anstie. The subacute form, such as that which is illustrated by Sir J. Paget's illness, of which he has given so graphic and practical an account in his 'Clinical Lectures,' is much more common. The channel of infection seems in these and the chronic cases usually to be the lymphatic vessels, whilst there is reason to believe that in some at least of the acute cases the poison passes directly into the mass of the blood through the veins. The first symptom, therefore, in most of the subacute cases is inflammation of the glands, with or without inflamed absorbents; and as the seat of inoculation is almost always the hand or forearm, the glands affected are the axillary. Frequently the inflammation and resulting suppuration is confined to these glands or the tissues which envelope them. At other times diffuse inflammation attacks the whole of the cellular tissue of the chest or back, leading to extensive suppuration. But the measure of the acuteness of the process and of the danger is given by that of the fever which accompanies these local lesions. However severe the latter may be, we expect the patient to recover so long as the pulse is fairly good, the temperature not excessive, the appetite tolerable, and the internal organs unaffected. But a patient in this state is always hanging on the verge of erysipelas, or pyæmia; and when a recurrence of rigors, or any symptom of mischief in the chest or joints, shows that the local poison has or may have passed into the mass of the blood, the prognosis becomes much more anxious.[1] Yet in many cases during the course of the local inflammation we see a low

[1] Sir J. Paget says: 'This seems to be a point of distinction between these dissection-poisons and pyæmia: their effects are at first, however severe, comparatively limited to the part poisoned, and to the lymphatic vessels and glands, or to the cellular tissue nearly in relation with it. They may lead to pyæmia, but they do this only by secondary changes or as it were by some accident.'—Op. cit. p. 331.

form of bronchopneumonia come on and pass off harmlessly. It is difficult to account for this otherwise than as the result of pyæmic poisoning, except in cases where (as in Sir J. Paget's) there may have been some previous illness which has left a predisposition to pneumonic inflammation. But I have seen the same event where no such predisposition existed; and it has seemed to me that the prognosis depends mainly on the time of occurrence of the chest-symptoms, being more favourable the longer after the injury they occur. There are other cases in which the disease begins, not in the glands, but as phlegmonous erysipelas of the limb, not necessarily starting from the wound, and other rarer cases of common cutaneous erysipelas occur; but these cases do not offer any other noticeable peculiarity. The danger is the same, the course of the constitutional infection is the same, and the treatment must be the same, in whatever part the erysipelatous inflammation commences—whether in the skin, the cellular tissue, or the glands. For it must be remembered that (as stated above) the relation between erysipelas and absorbent inflammation is a very close one indeed, and it seems a matter of perfect indifference whether the disease commences by one form of inflammation or the other, and whether it starts from the axilla or the forearm.

The chronic cases are those which are also happily by far the most common, being limited merely to inflammation with or without abscess of the glands, or slight absorbent inflammation with slight and transient disturbance of the general health.

Treatment.

In this, as in all other cases, prevention is better than cure. All students know the importance of having the hands well greased or oiled when performing a post-mortem examination in a case of acute internal inflammation; and if they are unlucky enough to prick or cut themselves, the first thing is to tie a ligature tightly round above, and then the wound should be at once squeezed, so as to encourage a copious flow of blood from it, and it should then be sucked for a long time, so that all morbid matter may be sucked out of it. It may then be right to cauterise it thoroughly, and undoubtedly this plan gives more security against absorption of virus, but of course at the expense of some inevitable local inflammation.[1] On the first appearance of any unpleasant symptom, rest, country air, purgation, and generous living are essential. Most surgeons agree in thinking that the reason why dissection-wounds are so much less fatal now than heretofore is because the so-called 'antiphlogistic' has been superseded by the stimulant plan of treatment. When the characteristic symptoms are developed the treatment must be conducted on the same principles as in other cases of blood-poisoning. Rest of body and quiet of mind (if possible) are of great importance, but the latter is not easy to obtain. I have usually found that surgeons, when overtaken themselves by any grave surgical malady, are peculiarly nervous and apprehensive, as, indeed, is natural. Yet such apprehensions are more common in the subacute than in the acuter and more deadly form of the complaint, in which the mind is too much oppressed to have much room for fear, and therefore the inevitable anxiety may generally be relieved by the assurance that such cases almost always end well. The patient's strength must be supported by such food and drink as he can easily and comfortably digest; and Sir J. Paget testifies to the relief afforded by free and early incisions into the abscesses, and I would add, into any inflamed part where tension is manifest, though no pus may be formed. And, as the same great authority intimates, it is probable that diligent and judicious nursing

[1] Some surgeons are opposed to the cauterisation of poisoned wounds. See Heath, 'Clin. Trans.' xiv. 120.

has quite as much to do with the patient's recovery as medical or even surgical treatment.

Wounds of venomous animals.

II. Wounds inoculated with matters which act as general poisons are chiefly those inflicted by the bites of venomous serpents, or the stings of venomous insects, though as to the latter, it seems that practically it is only the scorpion, and that only in very hot climates, whose sting produces any serious general symptoms. The insects of this climate, hornets, wasps, bees, &c., produce only local inflammation by their stings, and this so trivial as seldom to require any skilled assistance. Some form of ammonia (sal-volatile or eau de luce), indigo, in the form of the domestic 'blueball,' whitening, flour, ink, are some of the common remedies enumerated in the order of their apparent efficiency. It is said that bees' and wasps' stings inside the throat sometimes produce a degree of swelling which requires scarification.

So also, in this climate, the bite of a snake usually produces local consequences only. The common snakes, are, of course, perfectly harmless—in fact, are common and favourite playthings of schoolboys—but the adder, or viper, is undoubtedly venomous. I never saw a case in which the venom produced any worse consequences than a sharp attack of phlegmonous erysipelas, though this may, of course, prove fatal. But the tropical snakes infuse into their bites a venom which acts as a specific poison, and in the most venomous species this poison is as rapidly and surely fatal as any substance known to pharmacologists. In the severest cases the effects are developed so rapidly as, according to Mr. Busk, to resemble those of prussic acid more than anything else, but usually an interval elapses. The symptoms may be divided into general and local. 'The first symptom, in nearly all cases, appears to be a general shock to the nervous system, attended with faintness, tremor, and great depression, sometimes with stupor, loss of sight, vomiting, trismus, and general insensibility. At the same time great and sometimes intense local pain is set up. The limb, if the wound is in one of the extremities, rapidly swells: at first pale, the surface of the swelling soon becomes red, and afterwards livid, and covered with phlyctenulæ filled with sanious fluid. In severe cases the swelling continues to spread through the whole limb up to the trunk or even through the entire body, whose surface assumes a jaundiced hue. The [local] symptoms, in fact, very closely resemble those of ordinary phlegmonous erysipelas. The constitutional symptoms, independently of the first shock, are what might be expected to accompany such a local affection, and in intensity are in proportion to its violence.'[1] Mr. Busk points out the analogy between this dreadful poison and the ferments which act in the blood to develop the most formidable kinds of fever, as small-pox, and to the dissection-poisons of which we have just spoken. But he also dwells on the fact that, unlike those poisons, which produce (as far as is known) the same intensity of symptoms, whether they are introduced in small quantity or large, the serpent-poison depends for its intensity directly on its quantity in relation to the mass of the blood into which it is introduced; so that two bites will kill the same animal more quickly and surely than one, and a similar bite from the same serpent will act more intensely on a small animal than a large one. The situation of the bite also influences the rapidity and certainty of the action, a bite on the face or trunk being far more dangerous than one on the extremities. The knowledge of these deadly animals is essential to those who have to practise in tropical climates, but the present work is hardly the place for any description of them.

[1] Busk, in 'System of Surgery,' vol. iii. p. 856; 3rd ed.

I must refer the reader, for a condensed account, to the essay of Mr. Busk above quoted, and for more complete anatomical and zoological details to the special works on the subject, and particularly on the subject of the Indian snakes, to Sir J. Fayrer's great work, 'The Thanatophidia of India.'

The treatment of these injuries must be divided into the prophylactic and the curative. As in all poisoned wounds, the most effectual treatment is at once to tie a ligature tightly round the limb above the wound, to excise the part freely with a sharp knife, and then to suck the blood out repeatedly,[1] and cauterise the surface deeply before removing the ligature; or if the finger is the seat of the bite to cut it off at once.

But it is obvious that opportunities for adopting such precautions can very rarely be afforded. Then arises the question, is any other treatment of any avail? Now, it must be premised that the venomous serpents differ greatly in the activity of their venom; that the probability of inoculation and the intensity of the poisoning will differ according as the poison-gland is full or empty; and that a person may be bitten without any penetration of the skin having been effected, or any of the virus being brought into contact with the absorbent vessels.

The intravenous injection of ammonia in serpent-bites.

Thus it is never quite certain, when a person recovers after the bite of a deadly serpent under a certain mode of treatment, whether he has recovered in consequence of the specific effects of the treatment, or in consequence of the insufficiency of the dose of the poison; and this objection has been made to the only method of specific treatment which it is in the least worth while to discuss, viz. the intravenous injection of ammonia, and made on the great authority of Sir J. Fayrer. He attempts to show that in wounds produced by the deadly serpents of India, when those wounds fairly penetrate the skin, the injection of ammonia into the veins rather hastens death than otherwise, and he regards the plan as positively hurtful. The recoveries which have ensued in Australia he explains as due to the less poisonous nature of the serpents of that country, or to the insufficient injection of the poison. Yet it must be admitted that in many cases of serpent-bite in Australia the poison seems to have been potent enough to produce death when no treatment has been adopted; that the symptoms described in many of the Australian cases have been very alarming, and that the treatment seems to have approved itself to persons of experience, so as to have come widely into use in the country in which it was devised. And as to the increased danger which the injection itself may cause, it is surely a matter of very slight importance. In a case which is certain otherwise to prove fatal in a very short time it matters little whether the treatment employed exposes the patient to the danger of dying a few minutes sooner, provided only that it offers any reasonable chance of safety. And I must say that to my mind it is quite clear that Prof. Halford's treatment, whether it is sufficiently energetic or no to combat the effects of the virus of the most deadly serpents, has acted beneficially, and, as far as we can judge from published accounts, has saved life in many of the bites from the Australian serpents, and deserves to be fully tested in those of other countries. Prof. Halford directs that the liquor ammoniæ fortior is to be diluted with two or three times its bulk of water, and of this mixture from 20 to 80 drops are to be injected into any vein which is available. If the symptoms are relieved, but the patient seems still in danger, the injection may be repeated as soon as the operator thinks it prudent.

[1] It is usually believed that there is no danger in sucking the poison out of any wound, except the danger of there being a crack or wound in the mouth, by which the poison may be absorbed.

If this treatment is delusive, no other is at present known; the various specifics so-called, such as the Tanjore pill, the decoction of snake-root, &c., are, I believe, admitted to be inert, and the only thing that can be done is to keep the patient alive by copious stimulation or artificial respiration.[1]

III. The next class of poisoned wounds is that in which specific diseases are excited. These are wounds poisoned by the secretions from diseased animals, viz., Glanders, Hydrophobia, and Foot- and Mouth-disease.[2]

Glanders in the horse, and in man also, appears in two forms, one of which is acute and very deadly—*acute glanders*, or *glanders proper;* the other is chronic, and often followed by recovery—*farcy*, or *chronic glanders*. Glanders consists essentially in the eruption of a number of inflammatory deposits under the mucous membrane of the respiratory passages in the face. These deposits, or 'buds,' somewhat resemble the gummata found in syphilis, but they are much more rapidly formed. Accompanying this eruption is a general inflammation of the whole sub-mucous tissue, and usually also (though not always) a vesicular or pustular eruption on the free surface of the mucous membrane. Previous to the eruptive stage there is a premonitory feverish stage, characterised by general indisposition, with peculiar wandering pains, followed by feverish excitement and shivering, and succeeded by pains which simulate rheumatism, and which appear to be often due to an eruption under the skin similar to the glanders-eruption under the mucous membrane. The longer the premonitory stage is delayed after inoculation, and the longer the eruption is delayed after the premonitory stage, the more hopeful is the case.

The glanders-eruption attacks the internal organs, especially the lungs and pleuræ, and less commonly the testicle, kidney, pancreas, and the synovial membranes. Besides the eruption in or under the skin and mucous membrane there is a peculiar affection of the lymphatic vessels and glands, to which the name 'farcy' is more particularly appropriated, and which consists in the development, in the course of the lymphatic vessels, of tubercles—'farcy-buds' as they are called—which appears to be exactly similar to the tubercles constituting the glanders-eruption. And coincident with this are the usual symptoms of diffused inflammation and obstruction of the lymphatics, pain, œdema, suppuration, and ultimately permanent laming of the affected limb.

It seems almost a pity to describe the disease under two different names, since glanders and farcy, as above described, do not differ from each other in any essential particulars, and the inoculation from a farcy-bud will produce glanders and *vice versâ*. Sometimes the term glanders is restricted to cases in which the nose is affected, and farcy to those in which it is not: a more intelligible though an equally arbitrary division.

Virchow describes the tubercles of glanders (or farcy) under the skin thus: —'At first there appear some red spots, which are very small and resemble flea-bites, and soon acquire a papular elevation, subsequently rising above the level of the surface like small shot, assuming a yellow colour. These shot-like knots are either flat or round, and do not lie in a bladder-like elevation of the epidermis, but in a kind of hole in the corium, as if the latter had been punched out. They are not always solitary, but often disposed in groups. There is some surrounding injection, and under the epidermis there is found

[1] An interesting summary of some experiments on intravenous injection and artificial respiration in snake-bite will be found in 'Brit. Med. Journ.' June 19, 1875.

[2] Possibly the malignant pustule or 'charbon' might be added to these, but I have thought it better to place this in the same chapter with Carbuncle, under the affections of the SKIN.

a puriform and yellow fluid, seemingly consistent, and which is chiefly formed from softening of the knot. They are composed of a homogeneous yellowish substance, which is pretty firm and somewhat brittle, and has a great resemblance to tubercle. Microscopically examined, they present an amorphous granular appearance, mixed with cell-elements and cell-growths, and numerous fat-globules.'[1] The eruption is formed by vesication over these tubercles, the vesicles soon becoming filled with pus, in which stage the eruption is likened to varicella. The action on the mucous membrane of the nose must be similar, but it is less easy to verify it. It is accompanied with discharge from the nose, which soon becomes purulent, œdema, and inflammation of the face, sometimes passing on to gangrene, swelling and abscess of the salivary glands and of the tonsils.

In its acute form the disease is very fatal, and sometimes very rapidly so. It proves fatal either by mere exhaustion or by a form of pyæmia in which the secondary deposits are found chiefly in the muscles and subcutaneous tissue, or from the effects of the glanders-eruption in the viscera, and particularly the lungs.

But glanders or farcy in the chronic form may not prove fatal though it is a very formidable disease, and usually leaves the limb crippled by long-continued suppuration and sloughing. In some cases acute glanders follows on chronic farcy, doubtless from auto-inoculation.

In some cases, denominated *flying farcy*, the farcy-buds subside without suppurating in one part while the disease shows itself in another.

The disease can only be communicated to man by inoculation from an animal similarly diseased—and the disease is only known in horses and asses; but there is no doubt when generated it is highly contagious from man to man, so that all possible precautions should be adopted; and it has been proved by experiment to be inoculable from man to the horse or ass.

Mr. Poland, who had seen several cases (which I fortunately have not, only one case having, as far as I know, been admitted into St. George's Hospital during many years, and that in my absence[2]), says that 'in the premonitory stage it can hardly be diagnosed from other forms of blood-poisoning, and that in the early eruptive stage it is very much like the small-pox, and may have its clotty feel; but when once the eruptive stage is developed all doubt is at an end: the presence of a peculiar exanthem, the local nasal discharge, if present, the erysipelatous blush in the face and eyes, the tumours and knots in the cellular tissue and muscles, and the local suppuration sufficiently attest its character.'

The disease, both in horses and men, is now, we may hope, becoming rarer in consequence of its being better known, and in consequence of the greater attention which is paid to the cleanliness and ventilation of stables. It ought never to be generated in the horse, and if it is the animal should be killed at once. If a groom or anyone handling a horse supposed to be glandered is so unfortunate as to get any of the matter into a crack on his hand, or on to the naked hand (whence it is probably transferred to the nose in most instances), or if any is blown directly into the nose, the same prompt and decisive measures should be adopted as are recommended in serpent-bites or the bites of rabid animals; that is to say, the poison should be destroyed as promptly and as speedily as possible by caustic, and if possible a ligature should meanwhile be tied above the part inoculated.

[1] Poland, from 'Handb. der Path. u. Ther.' Bd. ii. Abth. 1.

[2] It is described by Dr. Dickinson, 'Lancet,' March 1869.

The treatment of glanders and farcy offers nothing that is peculiar. Its principles are, first, to disinfect and deodorise the discharge; and, secondly, to support the patient through the fever. For the former purpose the nose should be freely washed out either with creasote lotion, as recommended by Dr. Elliotson in his original paper in the sixteenth volume of the 'Medico-Chirurgical Transactions,' in which the disease was for the first time accurately described, or with Condy's fluid or carbolic acid. Mr. Poland speaks with approbation of turpentine embrocations and fumigation with volatile stimulating antiseptics, conveyed through the medium of warm vapour. The second indication is to be carried out (as in dissection-poisons) by free and early incisions and the judicious use of stimulants and tonics.

Equinia mitis.

Glanders, when fully developed, is hardly to be confounded with any other disease. Those who handle horses' feet when affected with a disease known to farriers as 'the grease' are liable to a slight pustular eruption in the hands and wrists, to which the name of 'equinia mitis' is given, in order to mark its origin and to distinguish it from the virulent constitutional poison of glanders. It is a merely local and perfectly harmless affection. The eruption consists only of the common phlyzacious pustules, instead of the hard shotty tubercles of glanders—there is no general disease—and the whole thing subsides in a few days with cleanliness and soothing applications. Such, at least, has been the course of those cases which I have seen, in all of which the hand alone has been affected; but one is recorded by Mr. Cock[1] in which the accidental inoculation on the nostril of the matter from a 'greasy' horse produced symptoms much resembling those of glanders. In other cases this eruption appears to have been identical with the ordinary vaccine eruption.[2]

Hydrophobia.

Perhaps the most awful of all diseases is that which is derived from the bite of an animal suffering under dog-madness, or rabies, and unluckily the apprehension often produces mental torture hardly less terrible than the disease itself. It is consolatory, therefore, to be assured that the disease in animals is very far rarer than might be inferred from the constant cry of 'mad dog' which is raised whenever a poor cur being worried into a bad temper bites and foams at the mouth. Dog-bites are extremely common—hydrophobia one of the rarest of maladies.

The disease derives its name from the dread of water which its development causes in the human subject, but rabies in the dog causes no such dread; in fact, the dog generally seeks the water greedily, though possibly spasm may prevent him from swallowing it. The disease in the dog ought to be known, in order that proper precautions may be taken:[3] but this is not more the province

[1] 'Lancet,' 1851, vol. ii. p. 129.

[2] See a case reported by Mr. Langton in the 'Clin. Soc. Trans.' vol. x. p. 121.

[3] The subject is so important in respect of precaution that I think it necessary to give the symptoms of dog-madness as described by Trousseau ('Clin. Medicine,' vol. i. p. 693. New Syd. Soc.'s Transl.), on the authority of Monsieur Bouley, clinical professor to the school at Alfort, 'based on what he had seen himself, and on quotations from Youatt's work':—'There are three well-marked stages of the complaint in the dog. The first is characterised by melancholy, depression, sullenness, and fidgetiness; the second by excitement, by rabid fury; and the third and last by general muscular debility and actual paralysis.

'Whether the disease originated *de novo* or was communicated, the dog looks ill and sullen after a period of incubation of very variable length; he is constantly agitated, turning round and round inside his kennel, or roaming about if he is at large. His eyes, when turned on his master or friends of the house, have a strange look in them, expressive of sadness as well as of distrust. His attitude is suspicious, and indicates that he is not well. By wandering about the house and yard he seems to be seeking for a remedy to his complaint. He is not to be trusted even then, because, though he may still obey you, yet he does it somewhat

of the surgeon than of any other person. A surgeon has usually to form his own opinion as to the presence of hydrophobia in the animal which inflicted the bite from the account given him by the patient or his friends when applying for advice on account of the injury, and I think I may say that the safest course—the one which is best for the patient, and that which is most likely to be correct in circumstances where anything like certainty is impossible (for it is difficult for anyone not very familiar with dogs to distinguish the early stage of rabies when he sees it, and still more so to judge on the subject from another person's description)—is to be very chary in admitting that the suspicion of the animal's madness had any foundation, and to give the most favourable

slowly; and if you chastise him he may, in spite of himself, inflict a fatal bite. In most cases, however, a mad dog respects and spares the person to whom he is attached. But his agitation increases; if he is in a room at the time he runs about, looking under the furniture, tearing the curtains and carpets, sometimes flying at the walls, as if he wished to seize a prey. At other times he jumps up with open jaws, as if trying to catch flies on the wing; the next moment he stops, stretches his neck, and seems to listen to a distant noise. He probably has then hallucinations of sight and hearing, seeing objects that do not exist, and hearing sounds that are not emitted. This delirium may still be suddenly dispelled by his master's voice, and according to Youatt, "dispersed by the magical influence of his master's voice, all these dreadful objects vanish, and the creature creeps to his master with the expression of attachment peculiar to him. There follows then an interval of calm; he shortly closes his eyes, hangs down his head, his forelegs seem to give way beneath him, and he looks on the point of dropping. Suddenly, however, he gets up again, fresh phantoms rise before him; he looks around him with a savage expression, and rushes as far as his chain allows him against an enemy who exists only in his imagination." By this time already the animal's bark is hoarse and muffled. Loud at first, it gradually fails in force and intensity, and becomes weaker and weaker, apparently indicating incomplete paralysis of the muscles of the jaws, just as the dropping down pointed to paralysis of the muscles of the forelegs. In some cases the power of barking is completely lost, the dog is dumb, and his tongue hangs out through his half-opened jaws, from which dribbles a frothy saliva. Sometimes his mouth is perfectly dry, and he cannot swallow, although in the majority of cases he can still eat and drink. When he has vainly attempted to swallow he probably believes it is because some foreign body sticks in his throat, for he puts his muzzle between his paws and works with them as if he wanted to get rid of this. Although he can no longer drink, people are misled into the belief that he does so from his lapping fluids with great rapidity. On close examination, however, the fluid is found to keep at the same level in the vase which contains it: anyone can see that the dog does not in reality swallow, that he does not drink, but merely bites the water. Although he cannot swallow fluids he can still in some cases swallow solids, and he may thus swallow anything within his reach—bits of wood, pieces of earth, the straw in his kennel, &c. This circumstance is one of very great importance to bear in mind, because when the body of a mad dog is dissected a good many substances which have not been digested may be found in its stomach, and do thus furnish a proof of the complaint.

'One period of the disease does not pass suddenly into another, but by an easy transition. Even in the first stage, that of depression and melancholy, the animal is from time to time very agitated, and shifts his posture. This agitation increases to a considerable degree, and in the second stage constitutes the rabid fury which characterises this period, together with hallucinations of sight and hearing. During this second period the animal drops down in a state of exhaustion after paroxysms of rage; he seems completely prostrate, his head hangs down, his limbs give way under him, and he can no longer swallow. These are signs of incipient paralysis.

'Towards the close of the second stage the dog often breaks his chain, and runs far away from his master's house; he wanders about in the fields, seized from time to time with paroxysms of fury, and then he stops from fatigue, as it were, and remains several hours in a somnolent state. He has no longer the strength to run after other creatures, although, if he is worried, he can still gather strength to fly at and bite an individual. If he be not destroyed as he wanders about he generally dies in a ditch or in some retired corner. He apparently perishes from hunger and thirst and intense fatigue; but veterinary surgeons do not say that he dies from asphyxia, brought on by spasm of the pectoral muscles or by convulsions.'

The disease is known to other animals—cats, wolves, horses, &c., and has been propagated by them to men—but its symptoms have only been fully described in the dog.

prognosis, yet at the same time not to neglect any of the precautions against the imbibition of poison which are used in other cases of poisoned wounds, and which are described on p. 69. When these precautions have been taken, or if, unfortunately, they have been overlooked, and any time over half an hour has elapsed, nothing further can be done; though even at a later period it is quite justifiable to cut out the bitten parts and cauterise the wound, in order to relieve the patient's own apprehensions, even if it cannot really affect the progress of the case.[1] What distinguishes the hydrophobia from every other form of poisoned wound is the great uncertainty of its period of incubation, and the incredible length of time during which the poison may remain latent, and yet ultimately break out in all the virulence of the disease. Many cases are recorded in which more than a year has elapsed between the receipt of the injury and the outbreak of the disease—one in which as much as five years and a half intervened—and though we might believe that in some of these cases a mistake has been made, and the disease has been due in reality to another injury which had passed unnoticed, or that in others hysterical hydrophobia has been mistaken for the real disease, yet we can hardly resist the conclusion that (in some mysterious and hitherto perfectly inexplicable manner) the poison contained in the saliva of the rabid animal may remain inactive in some part of the body for weeks or months, and then at length pass into the mass of the blood. Yet the neighbourhood of the wound displays no visible peculiarity, nor the absorbent glands nor any other part. The wound has usually quite healed, and the patient has often altogether forgotten the accident; so that the explanation which some have hazarded is quite insufficient—that the disease is really no affection of the body at all, but a mental disorder due to constant apprehension—a form of insanity. The disease undoubtedly originates spontaneously in the dog, but in the human subject it is only known as a consequence of inoculation.

Like other animal poisons, except perhaps those which are most virulent, the poison of hydrophobia is very uncertain in its action. Thus, if several persons be bitten, only one may suffer, as was the case in the instance which Dr. Marcet recorded in the first volume of the 'Medico-Chirurgical Transactions.' Trousseau estimates that about half the persons bitten take the disease. The disease begins not uncommonly with renewed irritation in the scar of the wound, or with irritation in the nerves leading from it, testifying to the fact that some morbid action is going on there. And there is often a period of sullen depression, a passion for solitude, and a change of temper and disposition exactly analogous to the first stage of rabies in the dog. There is also a general feeling of bodily *malaise*, differently described in different cases, but often referred to the nape of the neck, and sometimes mistaken for rheumatism or stiff-neck. Feverishness then succeeds, more or less marked in different cases, and then, at a variable period, the peculiar and characteristic feature of the disease manifests itself, viz. that any attempt to swallow fluids will produce severe paroxysms of dyspnœa; and in the worst cases these paroxysms

[1] In the 'Lancet,' November 24, 1877, will be found an interesting letter from Sir J. Fayrer, in which he relates a case where a gentleman had been bitten some hours before by a dog unquestionably rabid, and where the complete excision of the bitten parts, with cauterisation, was successful—at least no hydrophobia ensued. But the same letter also relates a case where of two persons bitten by the same rabid animal, one died of hydrophobia and the other escaped, though he was the medical man in charge of the patient and witnessed his agonising death. It seems to result from such cases that excision should be practised, even several hours after the bite; though the escape of Sir J. Fayrer's patient may have been unconnected with the operation.

are produced not only by attempts at drinking, but by swallowing anything, and even by the sight or the very idea of fluid, and in some cases they occur spontaneously. As the case proceeds, the mind, which was at first quite calm and reasonable, sinks under the agony produced by thirst and by constant restlessness, and the patient becomes more or less insane; yet is usually quite under control, and easily made conscious of his own delusions. The excitement increases, the eyes become wild and staring, the whole countenance expressive of rage mixed with terror; the patient is in a constant state of excitement, and gets hardly any sleep, and that little is unrefreshing and imperfect. As is also noticed in the lower animals, the sexual feelings are often inordinately excited, producing satyriasis and involuntary emissions, or, in a female, nymphomania. After this stage of excitement and mania often follows one of exhaustion, in which the patient recovers his reason and his power of swallowing, but dies of asthenia; at other times he dies in a furious stage, either exhausted or suffocated.[1] No perfectly satisfactory instance of recovery has hitherto been recorded, as far as I know.

It must be added, also, that though the disease is named from the dread of water, and though that symptom is a dreadful one, and the convulsions which drinking occasions may be terrible, yet patients who have sufficient resolution may overcome it, and may even take considerable quantities of fluid, and endure the contact of water in washing, as may be seen in the account of Dr. Marcet's patient above referred to.

The disease has never, as far as I know, been propagated from man either to other men or to the lower animals, though the saliva of hydrophobic men has been inoculated for experiment into the dog.

As to the real pathology of the disease nothing is known. That it consists in some disturbance propagated from the medulla down the eighth pair of nerves is clear enough; for though the leading phenomena of the disease have fixed attention chiefly on the mental disturbance produced by the sight or touch or thought of water, and the spasms which follow on attempts at drinking, we must remember that the disturbance is corporeal as well as mental, and the spasms are the effects of true reflex action proceeding from irritation of the hyper-sensitive afferent filaments. This is strikingly illustrated by a case which Trousseau relates (op. cit. p. 684) where an œsophagus-tube was passed through the nares and seven ounces of broth poured into it. Half of the broth had been conveyed into the stomach, when the pharynx and œsophagus were thrown into such violent spasm as to compress the tube and prevent the further passage of the broth, and the spasm spread to the respiratory muscles with such force that the patient very nearly died.

The post-mortem appearances do not, however, throw any more light on the nature of this irritation of the medulla or eighth pair of nerves in hydrophobia than they do on that of the spinal cord in tetanus. The fauces, pharynx, and stomach are found congested, and congestion of the brain and other internal organs has been noted, but the minute examination of the nerves of the part and of the nervous centres has hitherto led only to disappointment.[2]

The diagnosis of this affection seems easy enough. It appears that it may be mixed with tetanus,[3] but otherwise it can hardly be confounded with it, nor

[1] Trousseau seems to regard asphyxia as the usual if not almost the universal way of death in these cases.

[2] See, however, Dr. Coats's interesting paper in vol. lxi. of the 'Med.-Chir. Trans.' which, if confirmed, would show that there are evidences of irritation to be found by the microscope, both in the nervous centres and in the salivary glands.

[3] See Ogle, in 'Brit. and For. Med.-Chir. Rev.' 1868.

is there much difficulty in distinguishing the real from the hysterical (or, as Sir J. Paget would call it, the 'neuromimetic') form of hydrophobia. The course of the two diseases is quite different; the implication of the larynx in the spasms, so constant in hydrophobia, is absent in the simulated affection, and in the latter the patient is sure in the course of time to be able to swallow naturally.

The treatment is unfortunately quite unsuccessful. Surgeons have thought that if the patient's strength could be kept up for a certain length of time the irritation would disappear, and perhaps it might, but the attempt has hitherto proved futile. Forcible feeding, as in Trousseau's case above referred to, has produced such tremendous spasms as almost to kill the patient at once. Probably the administration of chloroform or the attempt to perform tracheotomy would do the same; yet it is a perfectly fair experiment to try until the experience of a few cases shall have demonstrated, as I fear it would, its inefficiency. It is suggested by Trousseau's translator, Dr. Victor Bazire, on the theory that the essence of the disease is asphyxia, and that if death by asphyxia could be prevented the patient might be saved. A great deal might be said against this view, but I need not detain the reader with the discussion in this place. Some have suggested excision of the nerve supposed to be affected, or amputation of the limb. Either operation may be justifiable under given circumstances, but neither holds out much rational prospect of success. Three patients are said recently to have recovered under the use of curare, and it seems that this drug is the most promising medicine which we possess for the treatment of hydrophobia. It should be administered at once, on the recognition of the disease, either by the mouth or hypodermically. One third of a grain was given in one of the successful cases, repeated as often as its effects appeared to be passing away; in another case three grains were injected during the space of 5½ hours; and in a third, quantities were used gradually augmenting from $\frac{1}{16}$th to ½ grain every third hour.[1]

Foot- and mouth-disease.—I shall say but little about this disease, since hitherto it has not assumed any great importance. It is desirable, however, that medical men practising in neighbourhoods where the disease prevails among cattle should be aware that the use of milk from infected cows is very liable to spread it to human beings, and particularly to children. The symptoms are those of stomatitis with a vesicular eruption on the inside of the mouth and on the tongue, and in some cases on the fingers and nails, and more rarely on the feet, breasts, &c. In young children there is sometimes severe inflammation of the mouth, throat, and tongue, and irrepressible diarrhœa. Otherwise the prognosis is uniformly favourable, and the complaint seldom lasts much more than a week.

The most important matter connected with this disease is to be aware of its existence—to take precautions for the supply of pure milk, and for boiling before use any which is at all suspected. Sulphurous acid ♏v–xx in syrup of orange peel and water has been found beneficial.[2]

[1] See Anderson, 'Syst. of Surg.' 3rd ed. vol. i. p. 341. [2] Ibid. p. 348.

CHAPTER IV.

HÆMORRHAGE AND COLLAPSE.

Hæmorrhage.

HÆMORRHAGE, its causes, sources, and treatment, forms a most important part of practical surgery, and in the judgment of many eminent surgeons it is in the treatment of unexpected and profuse hæmorrhage that the resources and qualities of a great surgeon are displayed more than in any other emergency. The topic follows naturally after the consideration of wounds and their treatment, since hæmorrhage is a symptom in every wound, and is the chief and most important symptom in many. Still a great number, perhaps the majority, of the cases of hæmorrhage which surgeons are called on to treat, are not traumatic; and the reader will see in the sequel that there are few surgical diseases in which the question of hæmorrhage does not at some time occur. It will hardly be possible, therefore, to exhibit in this place an adequate view of all the causes of hæmorrhage in surgical practice, nor, indeed, would it be desirable to repeat here matter which must form a great part of the sequel of the book.

Hæmorrhage may be looked at from several different points of view. Of these, the most important, and those to which I shall here confine myself, are two—viz. (1) as to whether the hæmorrhage is spontaneous or traumatic, and (2) as to whether the bleeding is from one or more large vessels (arteries or veins), or from a great number of small ones.

The hæmorrhagic diathesis, or 'hæmophilia.'

Spontaneous hæmorrhage is best illustrated by that curious affection which is seen occasionally in this country, and more frequently, it is believed, in Germany, called the *hæmorrhagic diathesis*. In this diathesis there is a constitutional predisposition to bleed, sometimes with no previous injury, but commonly after some slight wound, very frequently that of the removal of a tooth, or some other trifling laceration; and the hæmorrhage will proceed, sometimes, unchecked by treatment, until the patient is exhausted, when it commonly stops, though in rare cases it proves directly fatal. It is more common for death to follow some other disease, which the patient would if stronger have thrown off.

The constitutional tendency is hereditary, and usually in the males of the family. Females suffer also from the disease, but more rarely—an exemption which has been attributed to the natural outlet provided by menstruation. And it is asserted that men who have hæmorrhoidal discharges sometimes procure thereby the cessation of the hæmorrhagic diathesis. It seems, however, that though females suffer less frequently than males, the diathesis is commonly received through the mother. It is not, however, always inherited nor always congenital; and it is said that the diathesis may be excited by privation of exercise and confinement in a damp, unhealthy place.

In some cases the hæmorrhage is periodic; and it is sometimes preceded by a distinct warning—a period of excitement, in which the pulse beats excessively; the patient is restless, and perceives an odour of blood in his nostrils. Some days after this the bleeding will begin, or if an injury is received the wound will bleed forthwith. In the intervals between the attacks of hæmorrhage a peculiar affection of the joints may be noticed, varying

from severe pain to synovial effusion, or the general inflammatory thickening of all parts of the joint called 'white swelling.' So long as the joint-disease is present the tendency to bleed seems to be suspended. The nature and situation of the hæmorrhage vary; subcutaneous hæmorrhage (petechiæ), bleeding from the nose and mouth, hæmaturia, and melæna are the most common.

Treatment.

The treatment is generally successful. If the patient is strong enough to bear it, free watery purging (as by Glauber's salt, sodæ sulph., in ʒss doses) seems very beneficial, and the exhibition of some salt of iron (the carbonate is the favourite preparation) in the intervals between the hæmorrhages is often a great adjuvant. When internal hæmorrhage occurs the ergot of rye is highly recommended, and may be given in 5-grain doses every half-hour. External hæmorrhage is best controlled by well-regulated pressure, aided by some astringent, of which the perchloride of iron is the best, or in some cases by the actual cautery. In some instances it has been noticed that the bleeding has ceased on converting a lacerated wound into a clean incised cut, and venæsection has even been practised with advantage; but it seems unnecessarily dangerous to make fresh wounds in a case where any cut may bleed uncontrollably.

General symptoms of hæmorrhage.

The general symptoms of hæmorrhage are as follows:—When profuse and rapid (as, for instance, when a large artery is laid open) the patient rapidly faints; or, if the hæmorrhage is less excessive, the pulse and temperature fall, and he feels weak and faint; languor, yawning, noises in the head, throbbing of the temples, and flashes of light in the eyes precede the access of syncope. When syncope occurs, the bleeding as a rule stops; but if this is not the case, in consequence either of the size of the vessel or from some mechanical impediment to its closure,[1] the patient must die unless the bleeding is arrested by surgical treatment. Generally, however, it does stop, but sometimes recurs with the same train of symptoms, only more rapidly ending in syncope. On recovery from syncope vomiting often takes place, the pulse rises rapidly in rate, but not in volume, being weak, small, and easily affected by any external agency.

The recurrence of hæmorrhage after syncope is prevented by the blood forming a clot in the bleeding vessel and in the tissues around it, which the returning circulation is too weak to displace; and this process is greatly favoured by the contraction and retraction of the arteries when completely divided, as will be explained further on.

Symptoms of repeated or habitual hæmorrhage.

Repeated or habitual hæmorrhage produces a general pallor, or rather a waxy appearance, of the whole body, fainting on slight exertion, restlessness, emaciation, sometimes partial or complete amaurosis, and frequently constant and extreme drowsiness. As it goes on the patient becomes more and more weak and exhausted, sometimes entirely unconscious, pulseless, and livid. Death takes place usually in a very sudden manner, or is caused by some slight exertion.

It is hardly possible to estimate correctly the quantity of blood-loss which is necessary to occasion death. It varies much with age: infants succumbing rapidly—much with the patient's state of mind: a hæmorrhage which would not prove fatal if the patient were unconscious may easily cause death when his mind is agitated and his heart under the influence of terror—much with

[1] The main mechanical obstacles to the closure of the vessels are their dilatation by heat (as in the case of vessels wounded in the interior of the body), their being kept open by the walls of a bony or fibrous canal in which they lie, their partial division, and the presence of foreign bodies in their interior.

the temperature in which he is placed: bleeding which would not prove fatal if the patient were in a warm place may cause death when the heart is embarrassed by the resistance offered by tissues congealed by cold—with the organ affected, and with the condition of health or disease in which he may happen to find himself.

It has often been noticed that after repeated bleedings (either accidental or therapeutic) the blood becomes watery, more prone to escape from the vessels, even without injury, and less apt to coagulate.

Injuries of arteries.

The bleeding which occurs in most wounds proceeds chiefly from the capillaries and from small vessels which cease to bleed spontaneously. But bleeding from the larger arteries must be at once stopped, or else it will prove fatal, or at any rate cause a most injurious loss of blood.



Fig. 13. The axillary artery showing laceration of its two internal coats, which have been dissected, by the force of the blood-stream, from the external coat for about half an inch, and turned down into the cavity of the vessel, so as to block it up. *a* shows the coagulum lodged above the reversed portion of the inner coats; *b*, the sheath of the vessel, which was perfectly natural.—From St. George's Hospital Museum, Ser. vi. No. 98.

The injuries of arteries may be thus classified: 1. Contusion. 2. Partial laceration. 3. Complete laceration. 4. Partial division. 5. Complete division.

Contusions.

1. About contusion of arteries little is really known. It seems undeniable that contraction and even total closure of the artery may follow on mere contusion, and that this may be a cause of gangrene. So Guthrie relates a case in which a bullet passed between the popliteal artery and vein without opening either. Gangrene ensued, and the man died. 'The coats of the artery were not destroyed in substance, though bruised; it was at this spot much contracted in size, and filled above and below with coagula.'[1] But such injuries can hardly occur uncomplicated, nor can the exact condition of the artery be diagnosed. They must be treated by the ordinary rules for traumatic gangrene.

Laceration of internal and middle coats.

2. Partial laceration of the artery consists in the tearing of the internal and middle coats while the external coat remains entire. I once had an opportunity of seeing the symptoms of this injury so clearly marked that it was easy to diagnose both the nature and the precise seat of the lesion. A man was brought into St. George's Hospital with a very severe injury to the head, caused by a fall from his horse, of which he died in 8½ hours. On examining him about an hour after his admission there was no pulse in one wrist; on the other side it was perfectly natural. The pulse had been felt in both wrists when he was first brought into the hospital. In the axilla the pulsation could be felt down to a certain point, and there it stopped at once. There was no bruise nor any other injury in the armpit. It was easy to see that the axillary artery had been partly torn at this spot, and that the torn coats had been pushed into the tube of the vessel by the blood so as to close the tube, and the condition of the artery was exactly verified by post-mortem examination, as is represented in the annexed figure.

[1] Guthrie, 'On Wounds and Injuries of the Arteries,' p. 22, case 24.

The injury here is precisely the same as that which is inflicted by the surgeon in the operation of tying the artery, but without the abiding irritation of the ligature. The artery, therefore, will not probably give way above the seat of the injury. It may expand into an aneurism of the kind sometimes called *false*—i.e. the sac formed only by the external coat (see the section on ANEURISM)—but more probably this part will become lined and filled with coagulum, and beyond the obliteration of the artery nothing further will ensue. Gangrene is less likely to follow than after the ligature of the artery.

Rupture or complete laceration; subcutaneous.

3. Rupture or complete subcutaneous laceration of an artery is more commonly seen in the popliteal than any other vessel. It must be the result of great violence, and is therefore usually accompanied by other lesions, such as laceration of the posterior ligament of the joint or rupture of the vein, and usually both. The circulation ceases, the pulse disappears from the lower arteries, the temperature of the limb rapidly falls, enormous extravasation of blood below the fascia distends the limb; in some cases a bruit can be heard. I have never seen any case where pulsation was present in the extravasated blood. Gangrene rapidly ensues if the limb is not amputated. Such cases are easy of diagnosis from the rapid fall of temperature, the great swelling, and the loss of pulsation in the arteries below the seat of injury.

But I have seen cases where some amount of circulation went on, and where pulsation was at first perceptible, though feeble, in the tibial arteries, yet where gangrene set in, though not so rapidly;[1] and after amputation the artery was found completely separated into two parts. Either the blood at first found its way from one end of the artery into the other, the rupture being complete, or, as is more probable, the laceration was at first incomplete, but the untorn part of the vessel afterwards gave way.

If the diagnosis can be made with certainty primary amputation is the safest course in the lower limb. In the arm the surgeon would tie the vessel if the swelling were increasing, or if not would trust to pressure on the artery above, with careful bandaging of the whole limb, and a compress at the seat of injury. But in the upper extremity, as in the lower, when gangrene has commenced amputation should be no longer delayed.

Complete laceration of exposed artery.

The total laceration of an artery in a wound, as when a limb is torn off by machinery, does not usually give rise to hæmorrhage; the artery is twisted by the force exactly in the same way as it is by the surgeon in an amputation, and it can be seen pulsating down to the lacerated part. The process by which it is closed will be described under the head of Torsion, further on.

Incomplete division.

4. The incomplete is often a more serious injury than the complete division of an artery, since the wounded artery is prevented from retracting. Thus, when arteriotomy was a recognised operation, the anterior temporal artery was punctured, and would continue to bleed as long as the puncture in the vessel corresponded to that in the skin. When the surgeon wished to stanch the hæmorrhage he cut the vessel across.

[1] A case is related by Mr. Pick, in 'Path. Trans.' vol. xvii. p. 74. in which the laceration was at first incomplete, and the patient was able to walk several miles after the accident. Gangrene came on very gradually, and amputation was not performed till thirty-five days after the injury. The two parts of the popliteal artery were still united by a fragment of the anterior wall of the vessel. Mr. Rivington has related in the 'Brit. Med. Journ.' Jan. 12, 1878, a very interesting case in which the popliteal vein was completely torn across, while the internal and middle coats of the artery were lacerated. There were also other lesions. In this case a clicking sound was heard with the stethoscope, caused by the flapping backwards and forwards of the lacerated coats inside the artery; there being still a feeble pulsation in the tibial vessels.

The direction of the wound is of some importance in reference to the probability of future mischief. Thus, if a longitudinal wound be inflicted on an artery in a living animal, and the wound be afterwards examined, it will be found to be a mere slit, while a transverse wound gapes open and becomes oval, or rather lozenge-shaped, in consequence of the state of longitudinal tension in which the vessel normally is placed, rather than from any retraction of the muscular fibres. Mr. Savory shows that a similar shape is assumed by transverse wounds made after death, and that on dissecting the artery away and removing it from the body the wound closes again.[1]

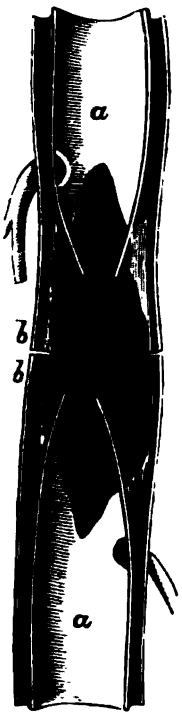


Fig. 14. Diagrammatic representation of complete division of an artery. The ends of the vessel (*a a*) are seen to be *retracted*, i.e. drawn up into the sheath; and *contracted*, i.e. compressed into a conical shape by the contraction of the circular muscular fibres. The part of the sheath thus left vacant, and the ends of the vessel, are represented as filled with clot. The clot often extends as far as the nearest branch on either side, tapering as it extends up the vessel, and is also poured out external to the sheath. The cut in the sheath (*b b*) is here represented as a linear fissure. In practice the sheath would gape more widely, as it is on the stretch.

An artery partially divided will go on bleeding until some efficient external obstacle is opposed to the exit of blood, and this is often effected by the displacement of the various layers of tissue overlying the vessel (so that the wound in the artery no longer corresponds to that in the skin), and by the accumulation of blood-clot in the interspaces. When the bleeding stops, the wound may close like any other wound, or it may give way to the distending force of the circulation till a traumatic aneurism has formed, as will be shown in speaking of ANEURISM.

There is another form of incomplete division, very rarely met with, in which the weapon has divided the external coats of the vessel, but without penetrating its tube. As it seems certain, however, that the internal (or internal and part of the middle) coat which has been left uncut will yield to the force of the circulation afterwards, this injury is to be regarded and treated exactly as a wound penetrating the vessel.[2]

Complete division,

5. When an artery is completely divided it *retracts* and *contracts*. It retracts since it is always on the stretch, and therefore when divided its ends separate, exactly as those of any other elastic tube would do, and it contracts from the irritation of the injury acting on its circular muscular fibres and causing them so to narrow the calibre of the vessel that it tapers out into a conical end within the sheath.[3] This con-

[1] Savory, 'On the Shape of Transverse Wounds of the Bloodvessels.'

[2] For an illustrative case see Guthrie, 'On the Diseases and Injuries of Arteries,' pp. 328–9. A gentleman had cut his throat, inflicting a punctured wound on the internal jugular vein and a wrench on the carotid artery. Guthrie took up the punctured portion of the vein with a tenaculum, and included it in a ligature. The wound in the vein healed, and the ligature came away, leaving the vein pervious and without a trace of injury. The artery was not interfered with, and it gave way on the eighth day, causing so much hæmorrhage that, although both ends of the vessel were secured as soon as possible, the patient died of exhaustion soon afterwards.

[3] In Hunter's works, vol. iii. pp. 157 et seq., will be found some very interesting experiments on the contraction of the muscular fibres of arteries in the lower animals under the stimulus of exposure and loss of blood, and on the length of time during which they retain their vital property.

traction of the muscular fibres offers an obstacle to the circulation of blood through the vessel, and therefore to the occurrence of hæmorrhage, which is in proportion to the strength of the muscular coat, and is therefore much more efficient in the smaller arteries, where the muscular coat is very much stronger relatively to their size (and therefore to the pressure of the blood-stream on them), than it is in the great arteries, where it is entirely unable to resist the pressure of the circulation. Hence the total division of a large artery by a clean cut proves fatal at once unless the vessel is promptly secured, whilst arteries of smaller calibre will cease to bleed with or without the assistance of syncope. John Hunter says that he believes if a leg were amputated with no precaution for stopping hæmorrhage that the patient would not usually bleed to death, i.e. that arteries the size of the tibials would generally close spontaneously.[1]

Injuries of veins.

All injuries of veins are less formidable in their immediate consequences than similar injuries of arteries of the same calibre, in consequence of the diminished force of the circulation, and of the weakness of the walls of the veins, whereby the pressure of the neighbouring parts and of the extravasated blood is enabled to act on them much more powerfully. It is, therefore, much easier to stop venous hæmorrhage than arterial, and it is hardly ever necessary to tie any except the largest veins and those which are kept open by the walls of the canals in which they lie. But contusion, laceration, or any other injury to a vein may have very serious and even fatal after-consequences, quite apart from any danger of bleeding. Thus, Mr. Syme [2] has shown that many of the deaths after ligature of the arteries may with great probability be attributed to injury inflicted on the accompanying vein: and since surgeons have been more alive to this consideration the mortality after ligature of arteries has, I believe, decreased considerably. Further observations on this topic will be found in the chapter on DISEASES OF THE VEINS.

Entrance of air into veins.

Another very formidable consequence which sometimes follows wound of a vein is the entrance of the air into it. When the air rushes into the vein in such large quantities as to fill the right auricle of the heart with air it usually produces instant death,[3] for the air passes through the auriculo-ventricular valve and opens it; then, on the contraction of the ventricle, the air, being a much lighter fluid than blood, cannot shut the valve-flaps, and so the heart s action comes to a stop. When a smaller quantity passes in, the patient faints, but recovery often ensues. The entrance of the air (which, in practice, always occurs in surgical operations) is denoted by a whistling sound, after which syncope at once occurs. As far as I know, this has only hitherto occurred in operations on the neck or axilla, though it seems possible in other regions also: [4] and it appears to have become much rarer, if not altogether unknown, since operations have been more generally performed under the influence of

[1] 'An artery of moderate dimensions,' says Guthrie ('Dis. and Inj. of Arteries,' p. 222), 'such as the tibial or brachial, and particularly all below these in size, are in general capable, by their own intrinsic powers, of arresting the passage of the blood through them, without any assistance from art, or from the surrounding parts in which they are situated.'

[2] 'Principles of Surgery,' p. 97.

[3] This is sometimes done experimentally in killing horses. A pipe is inserted into the jugular vein, and then if about thrice as much air is blown into the vein as a healthy man can emit at one full expiration, the horse will fall dead. See Moore's essay in 'Syst. of Surg.' vol. i. 372, 3rd ed., to which I must also refer the reader for a full discussion of the various theories about the manner of death in these cases. I have only stated in the text the one which seems to me the most satisfactory.

[4] Dr. Cordwent has related a case of parturition in which he believes that death occurred from entrance of air into the uterine veins ('St. George's Hospital Reports,' vol. vi.).

full anæsthesia, the accident being no doubt often caused by the patient's struggles. The vein having been imperfectly divided, and being prevented from entirely collapsing by its adhering in part to the surrounding tissues, some sudden movement draws the incision open while the motion of the chest in inspiration is producing a tendency to vacuum in the venous system.

The remedies are those for profound syncope, viz. the recumbent position, forcing the blood towards the heart by chafing the limbs, exciting the heart to action by galvanism, administering ammonia by the nostrils and brandy by the rectum, and possibly, if there be time for it, injecting warm water into the veins in quantities of about 2 ozs. at a time. Mr. Moore, who proposes this plan (which has not hitherto been tried) directs that the head be raised and a vein in the neck be opened, in order that, if it be filled with air, the air may escape. The water is then to be injected with such force as would, in the operator's judgment, moderately distend the auricle. All the cases which have recovered have done so under the ordinary remedies for profound syncope long-continued, and sometimes after a long period of almost seeming death.

The occasional occurrence of this terrible accident will of course teach the surgeon caution in dissecting-operations about the neck and axilla.

Diagnosis of the source of accidental hæmorrhage.

When a surgeon is called to a case of hæmorrhage his first care is to stop it for the moment, which is always readily done, if there is an open wound and the bleeding comes from a definite point, by moderate pressure with the finger on the bleeding spot. The bleeding even from a very large artery, if cleanly exposed (e.g. the femoral in a wound in the groin), requires remarkably little pressure to check it for the time. And if the bleeding point is not plainly visible, well-directed pressure on a pad of some soft substance filling the whole wound will suspend the hæmorrhage until time has been obtained for the definite treatment.

Arterial or venous?

Next the question occurs—Is the hæmorrhage arterial, venous, or capillary?

Let us suppose a large artery wounded, and the wound in the artery corresponding directly to the skin wound. The blood leaps out, of a bright red colour, in jets synchronous with the heart's beats, and often to a distance of some feet from the patient's body. In the wound of a large vein, on the other hand (phlebotomy is a familiar instance), the blood pours out in a dark purple (Modena-red) stream which is continuous, and, if jetting at all, the jets are not interrupted but only augmentations of the force and extent of the stream, synchronous not with the heart's action but with expiration or with muscular efforts.

So far there is no difficulty in the diagnosis. And in the case of smaller arteries there is also no difficulty so long as the flow of blood is unobstructed by the superjacent tissues. But in small wounds, even of considerable arteries, lying deeply and having a circuitous communication with the exterior, the bleeding may be so gentle that there is little to distinguish it from venous oozing in its manner of coming out or in its colour, for venous blood quickly turns red on exposure to the air. In this case the persistence of the hæmorrhage is a valuable sign that it is an artery which is wounded: and the effect of pressure above is another. Pressure applied to the nearest accessible trunk between the wound and the heart will suspend arterial hæmorrhage; while, if it affects the venous bleeding at all, it will augment it. If a bruit can be heard it will of course be decisive.

From trunk artery or branch?

Having settled that the bleeding is arterial, the next question is whether it comes from a trunk artery or a branch. The bleeding caused by a wound

of a branch close to its trunk (as of the superficial pudic near the common femoral, the circumflexa ilii near the external iliac, or the sural near the popliteal) has been constantly mistaken for a wound of the trunk itself. The main diagnostic sign is that the pulse in the lower part of the artery is very much more affected (not necessarily, however, suppressed) when the artery itself is wounded than when one of its branches is cut across, and the persistence of the hæmorrhage is a valuable sign of lesion of a main trunk.

Treatment of wound of artery.

When the hæmorrhage has been diagnosed to be from a trunk artery no time should be lost in securing it. If the position of the wound permits it a tourniquet, or finger-pressure, should be placed on the artery at some distance above the wound, or Esmarch's bandage applied;[1] then the wound should be enlarged sufficiently to permit an easy dissection of the wounded vessel, and the artery should be tied above and below the hole in it. If the wound in the artery is not at once visible, the relaxation of the tourniquet will show the surgeon where the bleeding comes from, and will lead him to it. A ligature above the wound only will sometimes stop the bleeding, especially in arteries of the lower limb; but even here it is far more safe to tie both ends. If this is not done, the lower end will probably begin to bleed as soon as the circulation is re-established; and it is an old observation, on which Mr. Guthrie used to lay very much stress, that the bleeding from the lower end is of a venous character, both in colour and flow.[2] This is certainly true of the arteries of the lower limb, but in the neck, and frequently in the upper extremity, both ends will bleed *per saltum*. Having secured the artery, the surgeon must examine the vein; or if there is a wound of a large vein, the bleeding from which is increased by the application of the tourniquet above, it may be held in check during the operation by another tourniquet below.[3]

Of wound of vein.

When the wounded vein has been exposed the surgeon must choose for himself, according to the size of the wound and of the vein, whether he will trust to pressure, or tie the vein as well as the artery. The superficial femoral and its vein have often been tied together (by John Hunter, Roux, &c.), the popliteal artery and its vein for a wound (by Mr. Holthouse), and the common carotid and internal jugular in removing a tumour (by Langenbeck), without bad consequences.[4]

If no tourniquet can be applied above the wound the operation becomes far more difficult and dangerous. The leading case here is one in which Mr. Syme tied the carotid artery when wounded at the root of the neck.[5] The left forefinger must be inserted into the wound (which is to be cautiously enlarged for that purpose sufficiently to admit the finger) so as to control all bleeding. Then, with the help of his assistant, the surgeon must bring the artery into view above his finger (i.e. between his finger and the heart), and when he has scratched it bare, and tied the ligature round it, he may remove his finger, clear all the clots away, and secure the distal part of the vessel.

If the wound in the skin has been commanded by pressure and there is no bleeding, the surgeon may think it better to wait, in order, should a trau-

[1] On a subsequent page a case will be found referred to, where the surgeon was enabled by the help of Esmarch's bandage to secure the deep palmar arch, above and below a puncture.

[2] Guthrie, 'Wounds and Injuries of Arteries,' p. 248.

[3] The application of Esmarch's bandage is usually more convenient on this account than that of the tourniquet, but some surgeons prefer the application of the tourniquet or finger-pressure in consequence of the facility of relaxing and reapplying it.

[4] See the account by Mr. Annandale ('Lancet,' April 24, 1875) of a case in which he tied the popliteal artery and vein in a case of arterio-venous aneurism.

[5] Syme's 'Observations in Clinical Surgery,' p. 154.

matic aneurism form, to treat it afterwards. But if the extravasation of blood be plainly increasing, the case should be treated just like a recent wound.

When the bleeding has been arrested by pressure it is, as a rule, unadvisable to disturb the dressings at all.

Ligature of artery above the wounded spot.

There are cases in which it is justifiable to tie the artery at some distance above the wound, as in aneurism. Thus, if the wounded vessel be inaccessible, as when the internal carotid has been wounded through the mouth, the common trunk has been tied with success;[1] or when the patient has already lost a great deal of blood, and the surgeon thinks that a prolonged operation and deep incisions would prove fatal, the artery has been successfully tied above, where it was more superficial.[2] But this must be allowed to be only a *pis-aller*, and if it fails to check the bleeding the patient will be in very serious danger. The only case in which the practice is recognised is that of a wound of the palmar arch.

In some cases also in which the wound and the limb generally are much inflamed it may be more prudent to tie the artery higher up; as recommended by Dr. Campbell of New Orleans (in a paper referred to on page 92); and the success of this practice in such inflamed wounds has led to the proposal of ligature of the main artery of the limb as a method of treating complicated wounds and diffuse inflammation of the limb generally.

There are rare cases in which the surgeon departs from the usual rule, of not tying an artery unless it is bleeding. These are mainly cases in which he judges, by the severity of the previous bleeding, that a large vessel has been wounded, and that the hæmorrhage will probably recur, and when the patient must be left at a distance from competent aid. Otherwise it is better to put careful pressure over the wounded part, and leave a tourniquet loosely applied over the trunk above, with instructions to the nurse to screw it down if the bleeding recurs, and send at once for the surgeon.

Ligature of arteries.

The ligature of arteries was a method of suppressing hæmorrhage so infinitely superior in every way to the cautery, which was previously in vogue, in freedom from pain, in ease of application, in efficacy, in safety, and in immunity from future ill-consequences, that it is hardly to be wondered at that Ambrose Paré, its inventor, declared that he considered it almost a divine inspiration. Many attempts have been made to improve upon the original invention, so as to avoid the division of the vessel which is involved in the separation of the ligature. I shall pass over most of these in silence, but shall describe in detail the most recent, which we owe to Mr. Lister's genius,

[1] See Mr. H. C. Johnson's case, in 'Lancet,' 1850, vol. ii. p. 118. This case is evidently alluded to in Mr. Guthrie's 'Commentaries,' 6th ed. p. 256, where he proposes to secure the internal carotid artery when wounded from the mouth by an operation in which the ramus of the jaw is to be divided along with the internal pterygoid muscle, and turned up, the styloid process and its muscles with the glosso-pharyngeal nerve dissected, some of the styloid muscles divided, &c. No surgeon would, I am sure, trust himself to attempt such an operation, and it is rendered the more unjustifiable by the fact, pointed out by Mr. W. H. Cripps, that it is usually not the internal carotid, but some branches of the external which are wounded in injuries of this sort. For this and other reasons Mr. Cripps proposes first to tie the external carotid, and afterwards, if necessary, the internal carotid near the bifurcation ('Med.-Chir. Trans.' lxi. 229).

[2] See Mr. Bulteel's case, 'Lancet,' 1859, vol. ii. p. 236, where a man was found nearly dead from hæmorrhage after a wound of the femoral deep in the thigh, probably in Hunter's canal. The surgeon, thinking that a long and difficult dissection must prove fatal in the desperate state of the patient, tied the artery in Scarpa's triangle, and the patient recovered without further bleeding.

and which gives fair promise of complete success. First, however, I must describe the method which is still in common use. If a vessel is to be exposed in its continuity, the skin and all other tissues which cover its sheath must be divided according to rules based on the known anatomical relations of each artery, and which will be found in the sequel. The sheath is recognised by the pulsation of the vessel beneath it, and by the absence of the white colour of the wall of the artery. It is pinched up with a pair of fine forceps, and a small nick is made in it with the knife held horizontally, so as not to endanger the artery. This little opening is enlarged with the point of the director till the aneurism-needle can be easily passed round the naked vessel. The sheath is only to be disturbed so far as is absolutely necessary for this purpose. Of all ligatures which are intended to divide the vessel, the best, as Dr. Jones[1] has conclusively shown, is a stout round silk or hempen string, which, being tied firmly on the vessel, cuts the two inner coats evenly all round.[2] These divided inner coats may possibly retract a little from the external, which alone is left in the grasp of the ligature. The constriction of the vessel brings the cut edges of the internal coats into apposition. The changes which now ensue are intended to effect (1) the separation of the ligature, (2) the closure of the divided ends of the artery, so as to obviate hæmorrhage, and (3) the restoration of the circulation. The ligature separates by a process of ulceration and sloughing, and when it comes away a small slough, consisting of the external coat, is generally embraced in the knot. There is, therefore, after the fall of the ligature, a time at which the artery consists of two parts, though these soon unite again, and though they are, as a rule, glued together by the inflammatory exudation which takes place in the tissues around the ligature. The separation of a ligature from a large artery such as the femoral occurs usually in about a fortnight. The earliest recorded period in that artery in a case which recovered seems to be eight days,[3] but it often remains fixed for a much longer period. When it separates very early hæmorrhage is much to be apprehended, the artery being probably diseased.



FIG. 15. Aneurism-needle. The point is rounded or blunt, and has an eye in it.

Process of repair after ligature.

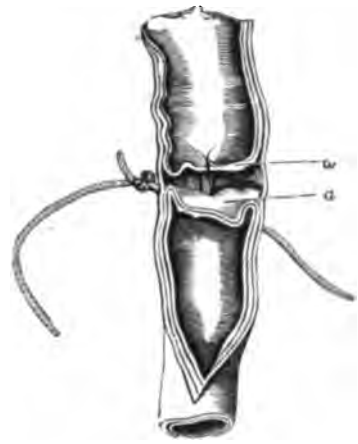


FIG. 16. An artery tied with a stout ligature and then laid open. *a, a* show the internal and middle coats divided and turned down for a short distance below the ligature, in order to expose the undivided external coat.

The means by which hæmorrhage is averted are chiefly threefold: (1) the blood coagulates in the interior of the artery, the coagulum extending in many cases to the nearest considerable branch on either side of the ligature, filling

[1] 'Treatise on the process of Nature in suppressing Hæmorrhage from divided Arteries, and on the use of the Ligature.' 1805.

[2] The internal coats are always more or less cut; but in making numerous experiments on arteries out of the body some instances will always be found in which the division is imperfect.

[3] In a case of Ramsden's tabulated by Norris, No. 45. 'Contributions to Practical Surgery,' p. 288, from Ramsden's 'Practical Observations.'

the whole tube, at least at the point where the artery is tied, and ultimately acquiring an organic connection to the wall of the artery; (2) the cut ends of the internal coats are united together by inflammatory lymph, and are also united to the lymph which is effused into the interior of the artery around the ligature; (3) the tissues around (sheath, cellular tissue, &c.) are occupied by inflammatory exudation, in which the tied part of the vessel is buried. Ultimately, after the fall of the ligature, the divided parts of the artery are united, and the whole of the portion of the vessel along which the coagulum has extended is converted into a solid cord.

During this process the circulation has been re-established by the increase in size of the anastomosing vessels. That increase is in some cases very rapid, in others, as it seems, very slow. The rapidity with which it goes on in the lower animals is seen from an experiment of Broca, who amputated the leg of a dog at the knee, having previously placed a ligature under the artery in the groin. The distance to which the pulsating jet reached was noted; then the ligature was tied; the bleeding of course ceased, but it recommenced at the end of one minute, and in five minutes the jet (which, however, no longer pulsated) had attained a quarter of its former maximum distance, notwithstanding that the quantity of blood in the body had of course been diminished by the hæmorrhage.[1] And many recorded facts show that, in man also, the circulation is very rapidly re-established, particularly in the upper extremity. Wardrop says: 'The enlargement of the anastomosing vessels to a certain extent takes place almost instantly after the trunk has been tied. I observed this in a child in whom I had secured the carotid artery. I could see the branches of the temporal and occipital under the delicate integument enlarging immediately after the operation.'[2] And instances are not wanting in which after the ligature of the main artery of a limb the pulse has been felt below the ligature in a day, or on the second day. But the anastomosing vessels continue to enlarge for a considerable period, estimated by Porta as being usually under a year. All the time during which the collateral circulation is deficient, the limb remains cold, weak, and liable to suffer from any rapid change of temperature; and even after it has attained its highest grade the limb in which the main artery has been tied is weaker, smaller, and less vigorous than natural.

Failure of process. Secondary hæmorrhage.

When any of these three steps are incomplete, the operation usually fails, either by secondary hæmorrhage or gangrene. If no clot forms in the artery —which from some unknown condition is not unfrequently the case—the force of the circulation in the upper end of the artery is resisted only by the uniting medium between the edges of the divided internal coats, assisted by the lymph which is deposited in and around the sheath. This, however, may be perfectly sufficient for the purpose, and accordingly we find cases in which the patient has recovered without any drawback, though only the very portion of artery embraced in the ligature has been obliterated (fig. 17). Still the deprivation of its proper support from the coagulum renders the uniting material much more prone to give way, and this is an indubitable cause of secondary hæmorrhage. Another and probably a more frequent cause is the extension of the ulceration (which is necessary for the separation of the ligature) beyond its proper bounds, so that it lays open a portion of the vessel not completely filled with clot. Perhaps both causes of secondary hæmorrhage may act at either side of the ligature, but obviously that form of secondary hæmorrhage, which depends on yielding of the uniting medium, must be

[1] Broca, 'Sur les Anévr.' p. 507, note.

[2] Wardrop 'On Aneurism,' p. 12.

more common at the upper end, where it has to bear the whole momentum of the direct circulation, than at the lower, where only the reflux circulation is acting. But the form of secondary hæmorrhage which depends on ulceration is, there can be no doubt, more common at the distal side of the ligature, though I am not aware that any satisfactory explanation of this fact has been offered.

Secondary hæmorrhage comes on about the time that the ligature is falling, though sometimes several days afterwards, and it usually commences gently, almost insidiously, so that the surgeon at first tries to persuade himself that it is merely a little oozing from the granulations of the wound, and this kind of secondary hæmorrhage may often be successfully treated by well-applied pressure. Pressure is best applied by graduated compresses in the wound, or by filling the wound with small-shot, which is to be firmly bandaged on, and an aneurism compressor adjusted over it; and it may be assisted by compression of the trunk above, which, if done at all, should be digital, much care being taken not to compress the vein. The limb should be carefully bandaged, and some authors recommend putting a compress of lint on the artery below the wound. But if the bleeding begin furiously, as from the upper end which has suddenly given way, or if pressure does not check it, three courses are open: to tie a higher part of the artery, to re-open the wound and place another ligature on the bleeding vessel, or to amputate. The ligature of a higher part of the artery, which used to be the orthodox treatment, almost always fails, and I quite agree with Mr. Erichsen that it only adds to the danger of the patient.[1] In a most interesting paper in the 'St. Bartholomew's Hospital Reports' (vol. x.) Mr. W. H. Cripps has shown that not only has it frequently caused death directly, but that it has usually failed to prevent the recurrence of bleeding, while yet in some of these cases a cure was obtained by the after-employment of compression. The attempt to re-tie the vessel at the seat of ligature is a dangerous and in some cases a very difficult operation; the tissues are loaded with blood, the artery is very difficult to recognise unless the bleeding is allowed to go on; and such renewed loss of blood may easily prove fatal to one weakened by previous hæmorrhage. Besides, the artery may be too rotten to bear a ligature, or the vein may easily be included with it. Still the attempt has proved far more successful than the ligature above. Amputation is, I am persuaded, the best treatment in many cases of aneurism; since it removes a formidable disease which is by no means cured at the time when secondary hæmorrhage occurs; but no one would willingly resort to it in a case of mere wound.

Treatment of secondary hæmorrhage.



FIG. 17. Portion of a femoral artery tied some months before death. A very small part, *b*, of the vessel (about ¼ in.) is reduced to the size of a piece of whipcord, being completely obliterated. Except a very small pale coagulum just below this narrowed part, the whole artery above and below this part is quite pervious and healthy. *a* shows the profunda artery, the chief branch above the ligature; and a large branch which comes off some distance below is also seen.—St. George's Hospital Museum, Ser. vi. No. 147.

[1] On the other hand, Mr. Maunder argues that the ligature of the vessel above renders the subsequent use of compression more likely to succeed, when the bleeding is from the proximal end of the wounded artery ('Surgery of the Arteries,' p. 93). Obviously, however, the use of compression after ligature must greatly increase the risk of gangrene.

The result of Mr. Cripps's inquiries is as follows. The paper includes all the cases which he could find of secondary hæmorrhage after the ligature of the femoral in its continuity for all causes, fifty-three in number. There were fourteen cases in which the external iliac was tied: twelve died, one recovered under pressure on the recurrence of hæmorrhage,[1] and one after amputation for gangrene; five others were amputated, two died, three recovered. In twelve cases the artery was re-tied: seven died, and five recovered. In fifteen cases pressure was used, and only three died. In seven cases, from various causes, no treatment was used, and three of these recovered.[2]

It might be argued, in explanation of the far more favourable results of pressure, that that method had only been used in the mildest cases; but Mr. Cripps says that on perusing the notes of the cases, he does not believe this to have been the fact. The perusal of the paper has certainly confirmed my previous impression, that most of the cases of secondary hæmorrhage which can be saved will be saved by the persevering use of well-applied pressure. But there are unquestionably in practice cases where secondary hæmorrhage bursts out with such violence from the upper end of the artery that it is useless to spend time on the attempt at compression. Such cases must be treated, I think, like fresh wounds of the vessel, by re-tying it; or, if the attempt to re-tie the vessel fails, by amputation. And there are other cases where the persevering use of pressure has failed. Here the surgeon must be left to choose between re-tying the vessel and amputation.

Secondary hæmorrhage occurs also from arteries that have been wounded and not tied, in consequence of the giving way of the clots, or of any uniting medium which may have opposed the issue of blood. The practical considerations are the same as after ligature. I ought to mention that secondary hæmorrhage is often said to be due to unhealthy ulceration, caused by defective hygienic conditions in hospital—a statement of which I have found no definite proof, though it is probable enough. Certainly the most common cause of secondary hæmorrhage is disease of the vessel. Secondary hæmorrhage in diseases.

Secondary hæmorrhage occurs not only after injuries, but also, and that very frequently, in diseases. Thus, after all forms of gangrene, secondary hæmorrhage may occur, though it is not very common, since the vessels are generally plugged around the gangrenous part. In sloughing and phagedenic ulcers, hæmorrhage takes place more frequently, though here again it is rare for the larger trunks to be opened. Hæmorrhage from ulcerating cavities, or from the granulations of a partially healed wound, the exit from which is in great part obstructed, is much more common. In the treatment of such cases of hæmorrhage, it is a matter of primary and vital importance to have the bleeding surface freely and fully exposed. Many a patient has been allowed to bleed to death while vain attempts were being made to check hæmorrhage by styptics, which would have subsided at once if the cavity had been exposed to the air by a free crucial incision. When the source of hæmorrhage is thus fairly in view, if it be a single vessel it can be secured, or if too much diseased to bear ligature or torsion, can be compressed or cauterised. Bleeding from numerous small vessels may be treated by styptics, and in a very

[1] In this case the surgeon in charge states his opinion that the ligature of the external iliac was a useless operation.

[2] In cases of secondary hæmorrhage from the stump of an amputation, the results of ligature of the artery higher up seem to have been less disastrous, but the number recorded here is very small. Three cases are referred to, in two of which the common iliac was tied after the external. All recovered.

few cases irrepressible hæmorrhage from a great trunk may be treated by the ligature of the trunk at a higher spot, or may even necessitate amputation.

Recurrent hæmorrhage.

There is another form of bleeding which is sometimes confounded with secondary hæmorrhage, though it is of quite a different nature. I mean the *recurrent* hæmorrhage, which sometimes comes on an hour or two after a wound, when the patient becomes warm in bed, and has recovered from the shock of the operation or accident. This depends merely on some vessel or vessels, which have not been secured, bleeding under the influence of warmth and renewed circulation. The bleeding vessels must be exposed and treated just as in primary hæmorrhage.

Gangrene after ligature.

The other main cause of failure after ligature is gangrene, and it depends usually, as it seems, on the failure of development of the collateral circulation. This, however, is by no means the only cause of gangrene, for it may be occasioned also by coagulation in the vein, the result of bruising or laceration of that vessel in the injury or in the operation, and in cases of aneurism it depends sometimes on inflammation of the sac, by which the pressure on the vein or veins is increased and the veins themselves in some cases also affected by inflammation. Gangrene from the two former causes commences early, usually within four days after the ligature; the latter cause may be several weeks in producing its effect. The treatment to be pursued depends on the rapidity with which the gangrene spreads. If it comes on over a large surface, or in several places at once and advances rapidly, no delay should be admitted, but the limb should be removed at once, the section of the artery being made as near as possible to the tied portion—not above it. If only a small part of the limb—say one or two toes—is affected, and the gangrene advances slowly, without constitutional symptoms, there is good reason to hope that the mortified parts will separate and a useful limb be preserved.

Recurrence of circulation.

This view of the causes of failure of the ligature would not be complete without the mention of what, however, belongs to the subject of aneurism, and not of hæmorrhage, viz. that the collateral circulation sometimes errs from excess. When the main artery is tied in order to cure an aneurism, or when the operation is performed for general inflammation of the limb (as recommended by Dr. Campbell and Dr. Onderdonk, in America, and in this country by Mr. Maunder [1]), the collaterals may enlarge so rapidly and to so great an extent as at once to reproduce the circulation below, which it was intended to suspend. The treatment of aneurisms when recurring from this cause will be spoken of in the section on that subject.

Carbolised catgut ligatures.

Viewing the great danger of secondary hæmorrhage and its comparative frequency (which, however, has been much diminished of late years, since arteries have been more gently dealt with in deligation, and the sheath disturbed to as small an extent as possible [2]), surgeons have long been seeking for some means of tying an artery, so as permanently to obliterate it, without dividing it. John Hunter attempted this in the very first operation which he performed, by gently constricting a large extent of the artery by means of four broad ligatures; but he soon recognised the futility of that attempt. Again, the same end was sought by the use of temporary ligatures [3] tied over a roll of lint, or some such substance, laid on to the artery so that the ligature could be cut and removed two, three, or more days after the operation; or by nooses

[1] See 'Biennial Retrospect of New Syd. Soc.' 1867–8, p. 284.

[2] 'Lancet,' 1874, vol. ii. p. 860.

[3] First used apparently by Cline and Scarpa. See South's 'Chelius,' vol. i. p. 304.

attached to an instrument left in the wound, whereby the surgeon could tighten or relax the ligature as he liked. And these attempts are not yet entirely given up, though, as far as I can discover, only one preparation exists showing that the artery has really been closed in this way in the human subject,[1] while the failures have been numerous and disastrous. Again, ligatures made of animal matter have been used in the hope that they would be absorbed (or perhaps, as some have thought, that they would unite with the tissues around) without causing any ulceration. The only one among the numerous experiments of this kind to which I need refer is the ligature of the femoral with catgut, which Sir Astley Cooper performed on an old man affected with popliteal aneurism,[2] and which proved most successful. But he was disappointed in subsequent trials of the substance, and renounced its use. Recently Mr. Lister has revived the use of catgut, thoroughly soaked in carbolised oil, as a ligature, and with a success which is, I think, undeniable.[3] The success depends, as I have endeavoured elsewhere to show,[4] not only on the material of which the ligature is composed being one which is capable of absorption, and which dissolves without exciting suppuration—though this is an essential condition—but also, and perhaps even more, on the rapid union by the first intention of all parts of the wound which are in contact with the tied vessel. We have already seen that the lymph effused in and around the sheath is a great support to the vessel and protection against secondary hæmorrhage when the artery is divided by a ligature. If this exudation forms rapidly, and without destructive inflammation, the tied vessel remains free from any tendency to soften or ulcerate, and the small knot of carbolised gut rapidly disappears, keeping the artery closed, however, quite long enough (as we know from the experience of acupressure) for permanent obliteration to occur. That this is, at any rate, possible is shown by a case in which I tied the subclavian and carotid artery in this manner, and where the patient died eight weeks afterwards from another cause. Neither wound had healed by first intention, but the suppuration seemed superficial. The external coat was perfect in both arteries, which were closed by a kind of diaphragm only at the point tied. This was the first definite anatomical proof that arteries can be obliterated at the seat of ligature without being divided, but similar cases have been since described by Mr. Treves and Mr. MacCarthy ('Med.-Chir. Proc.,' vol. ix.). Mr. J. R. Lane also, in a very interesting paper in the 'Brit. Med. Journ.,'

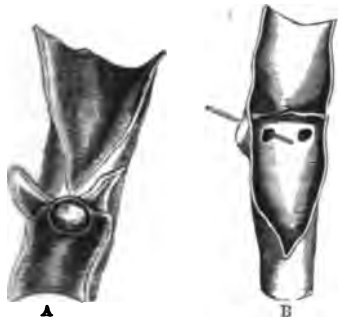


FIG. 18. A, the subclavian, and B, the common carotid artery, tied simultaneously with carbolised catgut on Nov. 16. Death took place on Jan. 9. The subclavian has been laid open above and below the seat of ligature, but not at the precise point. The external coat is seen to be quite perfect, and the tube of the vessel is closed by a simple diaphragm. In the carotid this diaphragm has been cut through and the artery opened in its whole extent. Two small fissures or cracks are seen below the ligatured part, one of which (marked by a small bristle) leads into a minute cavity outside the artery, containing blood-clot. The case is reported in the 'St. George's Hospital Reports,' vol. vi., and the preparation is in the Hospital Museum.

[1] This preparation is in the Museum of the Irish College of Surgeons.

[2] The case is related in Cooper and Travers's 'Surgical Essays,' vol. i. p. 125.

[3] 'During the last three years,' says Mr. Bickersteth, 'I have tied the femoral artery five times, the common carotid once, and the common iliac once, and in every case, with one solitary exception [one of the cases of ligature of the femoral], the wound has healed at once, and without suppuration.'—'On Recent Progress in Surgery,' 1871, p. 20.

[4] 'Lancet,' 1872, vol. ii. p. 325.

Nov. 10, 1877, relates two cases in which the artery was completely sealed, but its outer coat undivided. If this result could be attained in every case, secondary hæmorrhage would, of course, be unknown. But this is far from being the case, at least as yet. In some cases the catgut has softened prematurely, or perhaps has come untied, and the circulation has recurred; but this is very rare, and might probably be avoided by care in the preparation and tying of the ligature. In other cases, where suppuration has taken place around the vessel, secondary hæmorrhage has ensued;[1] but the constant use of this form of ligature in operations of all kinds for several years has convinced me that secondary hæmorrhage is far rarer than with the silk ligature, even in wounds which suppurate freely, while the ligature itself does not seem to be felt as a foreign body at all, or to interfere in any way with primary union.

Great care should be taken in selecting the material for the ligature. The catgut should not be too thin, and it should be steeped in the carbolised oil (1 part of the acid to 5 of oil) for many weeks before it is used. In fact, it seems that it continues to become tougher and more reliable for an indefinite length of time.[2] A convenient ligature-case for private practice is made of a thick glass tube with a silver cover screwed on, in which a reel of the catgut ligature can be kept in oil in the pocket for an unlimited time. It is well gently to wipe off the superfluous oil before use, as otherwise the ligature is a little apt to slip; and it is safer not to cut the ligature too near the knot, especially as the substance is very easily absorbed and creates no apparent irritation.

Two other kinds of animal ligature are in use, and, as far as our present experience goes, I am disposed to think them superior to the catgut for ligature of an artery in its continuity. The first is that made of the middle coat of the aorta of an ox, described by Mr. Barwell in the 'Med.-Chir. Trans.,' vol. lxii., and which I used with great success in an interesting case of ligature of the external (or possibly the common) iliac artery, recorded in the 'St. George's Hospital Reports,' x. 488. The other is made from the small tendons of the kangaroo's tail, and was used by Mr. Pollock in tying the subclavian and carotid artery at St. George's Hospital,[3] in a very successful case of ligature of the external iliac artery by Mr. Croft at St. Thomas's, and in many subsequent cases at St. George's and elsewhere.[4]

Method of tying arteries wounded in operation.

Wounded vessels used in former days to be secured by driving a sharp hook, called a *tenaculum*, through the bleeding mouth of the vessel and the tissues immediately adjacent, and then tying a ligature under the convexity of the hook. The tenaculum being now withdrawn, the ligature of course compresses the vessel a short distance from its cut end. This method, however, is somewhat rough, since a good deal more tissue is included in the ligature than is really necessary. It is, however, still often employed when the vessel lies in the midst of dense structures from which it cannot well be separated. Otherwise it is better to pick up the vessel, and separate it cleanly from the tissues around, drawing it slightly out of its sheath with one of the forms of



FIG. 19. Liston's Tenaculum (modified).

[1] See a case by Mr. Holden. 'St. Bartholomew's Hospital Reports,' vol. viii. p. 187.

[2] Mr. Lister has recently advocated the preparation of the catgut in chromic acid ('Lancet,' Feb. 5, 1881).

[3] Dent, 'Med.-Chir. Trans.' vol. lxiv.

[4] See Girdlestone and T. Smith, 'Med.-Chir. Trans.' vol. lxv. p. 71. Also a paper by myself, 'Brit. Med. Journ.,' June 9, 1883.

forceps here figured. The name *tenaculum* which used to be appropriated to the sharp hook is now more commonly applied to the forceps used for tying arteries. Each form has its advantages. Liston's, when closed, catches with a spring which holds it on the artery, and enables the surgeon to tie the vessels more easily when he has no assistant. Assalini's may be armed beforehand with the ligature, and I think enables the surgeon and his assistants to secure the vessels in a large wound more rapidly. But the use of one or other is more a question of fashion and habit than of any essential superiority.

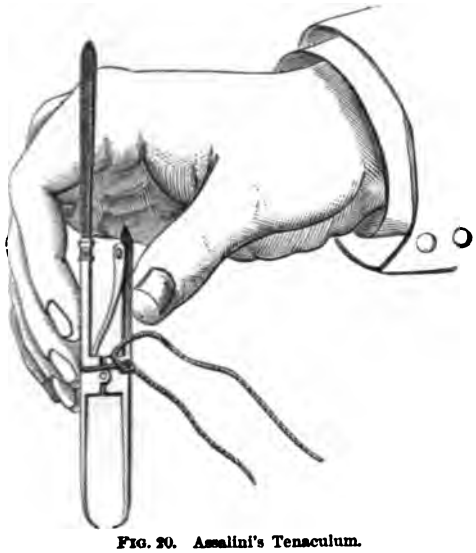


FIG. 20. Assalini's Tenaculum.

Acupressure.

I have spoken in the preceding sentences of 'tying' arteries, since this is the general, and for the moment, at any rate, the most certain method of securing them. But there are two other plans which have come much into vogue of late years, viz. Acupressure and Torsion. The chief object of these two methods is to avoid that which is the drawback of the silk or hempen ligature, viz. the abiding irritation and ultimate ulceration by which the ligature is cast off. In acupressure the metallic foreign bodies by which the artery is temporarily compressed are removed as early as is judged safe, and the wound is left free to unite. In torsion there is no foreign body at all.

The different methods of applying acupressure are reduced by Pirrie, its most ardent and considerable advocate, to three, which he has denominated



FIG. 21. Acupressure. First method, or *Circumclusion* (after Pirrie).

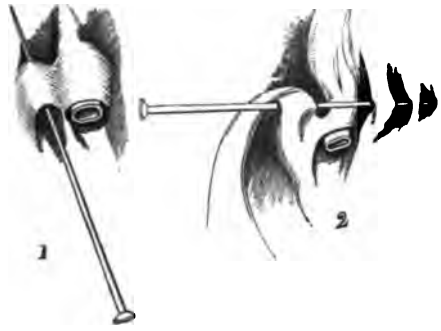


FIG. 22. Acupressure. Second method, or *Torsoclusion* (after Pirrie).

Circumclusion, Torsoclusion, and Retroclusion. In the first method (fig. 21) a pin is passed below the divided artery, and a loop of wire placed over the end of the pin compresses the tissues in which the artery is lying, and is twisted tightly enough round the stalk of the pin to stop all bleeding. Then the point of the pin is passed into the tissues, while the ends of

the wire hang out at the other side of the wound with the head of the pin. When the pin is withdrawn the wire of course becomes loose, and is drawn out also. In the second method (torsoclusion, or the Aberdeen twist), the pin is passed in parallel to the vessel (fig. 22 (1)), then twisted round a quarter of a circle and driven across the vessel into the tissues on its further side tightly enough to keep it in its new position (fig. 22 (2)). In the third method, retroclusion, the pin is passed first above the artery, under a few muscular fasciculi only (fig. 23 (1)), then twisted round half a circle and driven below the artery into the tissues on the side where it first entered (fig. 23 (2)). The pins are withdrawn as early as the surgeon thinks it safe. Dr. Pirrie gives eight hours for smaller arteries, such as the facial, temporal, radial, ulnar, mammary, and spermatic, and twenty-four hours for such as



1 2

FIG. 23 Acupressure. Third method, or *Retroclusion* (altered from Pirrie).

the humeral, axillary, and femoral, as periods at which the pins may be safely withdrawn; and he intimates his belief that it will be found safe even to shorten this period.

I have had sufficient experience of acupressure to testify that it is a perfectly efficient means of stopping hæmorrhage, and one which, with a little practice, is not difficult of application.

Torsion.

Torsion is a very old method of stopping hæmorrhage. It was extensively used in the last generation, and the readers of Porta's great work[1] will know that he employed it successfully in many of the major operations; but it passed out of practice, probably in consequence of the loss of time which it sometimes occasions, and which was a very important consideration in operations performed without anæsthetics. It was revived by Mr. Syme, and is now used by many of the best surgeons. The action of torsion is very easy to understand. If the divided end of a large artery be taken hold of with a pair of forceps, all other tissues being carefully avoided, and twisted round four or five times till its coats are felt to give way, it will be found on laying it open that its internal coat has been torn, and the middle coat has also been separated from the external, torn, and twisted up into the tube of the vessel, which is therefore closed by a firm plug, while the external coat remains uninjured, though more or less twisted. Even in the dead subject the vessel is so firmly closed that no fluid can be forced through it. In a large wound, such as that of an amputation, when all the divided arteries have been thus treated, the wound is left entirely without any foreign body. It is true that the twisted ends of the vessels may slough and come away, but it seems certain that this is exceptional in skilful hands.

Torsion is not easy to perform successfully, and this difficulty is felt even more with the smaller arteries than the larger ones. This depends on the

[1] 'Sulle Alt. pat. delle Arterie,' published in 1845.

difficulty of isolating the latter from the tissues around, especially while they are bleeding; and it is on this proper isolation that the prompt success of torsion in stopping bleeding depends. A large artery can be easily drawn out of its sheath, and then two methods of twisting it are employed, called *limited* and *free* torsion. In the former the artery is drawn out of its sheath, seized with forceps about an inch above the divided end, and then twisted with a second pair of forceps so that only the part between the two pairs of forceps is twisted; in the latter it is merely drawn out and twisted freely. Small vessels can, of course, hardly be twisted in any other than the latter way.

If it is necessary for me to express an opinion on the value of these methods of arresting arterial hæmorrhage, I must commence by saying that both acupressure and torsion are perfectly reliable methods of arresting hæmorrhage. They have been used for many years together by eminent surgeons in large operative practice, without any accident or bad result. It is, therefore, merely as a matter of private opinion that I say that neither acupressure nor torsion seems to me so convenient, so safe, or so likely to promote the rapid union of the wound as the carbolised ligature. The latter, as I have tried to show in the preceding description, is perfectly easy to apply, takes up no appreciable space in the wound, holds the artery closed as firmly as the silk ligature does, and for a longer time than is found necessary to keep the largest artery compressed, excites no irritation or suppuration as it gradually melts away, and does not interfere in any degree with primary union. Both the other methods are more difficult to practise. If a great number of vessels require to be secured, the mass of pins and wire-loops renders acupressure very inconvenient, distending the cavity of the wound, and effectually preventing all primary union: and when bleeding proceeds from a number of small vessels, torsion is a very tedious business even in the hands of those most versed in it. Secondary hæmorrhage is certainly rare after either method when practised by experienced surgeons; yet I should hardly think anyone could leave a large artery after either acupressure or torsion, in a patient not under his immediate eye, with the same comfortable security as he would feel if the vessel were properly tied; and I have certainly seen very acute and sudden hæmorrhage a few days after torsion, in all probability from detachment of the crushed end of the artery.



FIG. 24. Torsion-forceps. The artery to be twisted being caught being the blades of the forceps, they are closed as far as the thickness of the tissue embraced by them will allow, and the catch on the upper blade is then pushed down as far as it will go. The wedge-shaped projection from the lower blade enables the catch to hold the forceps firmly closed, whatever may be the distance between the blades. This is one of the most convenient and efficient of the many forms of catch-forceps for torsion.



FIG. 25. Torsion. Taken from a large artery which was removed from the body before it was twisted. The internal and middle coats are seen to be separated from the external, and pushed up the tube of the artery like a plug.

In London we have taken up this question with no prejudice for or against either method, and the result has been that acupressure is, as far as I know, universally disused after a fair trial, and torsion is only practised at a few of our hospitals.

Had I to choose, however, between the silk ligature and torsion, I do not think that I could speak with equal confidence, for the ulceration and sloughing caused by the silk ligature must of necessity prevent complete union by the first intention; while torsion, if dexterously and rapidly effected, usually does not do so.

Other means for arresting hæmorrhage; unci- and forci-pression.

There are cases in which a considerable artery is wounded, yet where it can neither be tied, compressed, nor twisted. In some such cases, as before stated, it is justifiable to tie the artery or arteries higher up, as is often done in wounds of the palm. Yet it must be allowed that the practice is an uncertain one, and has often led to loss of limb or life. No doubt in many such cases more accurate pressure would have been successful. Professor Vanzetti has lately proposed for such cases a plan which he calls 'uncipression,' and which I think is well worthy of a trial. A pair of sharp hooks, double or single, according to circumstances, are dug into the two sides of the wound, so as to make pressure on the bleeding point or points, and these hooks are fixed by an elastic band to a splint on which the limb rests, or to something at the side of the bed. The hooks may be mounted on handles or on a chain, like the ordinary dissecting-hooks. See 'Medical Record,' March 8, 1875, where another plan of applying compression may also be seen described by M. Verneuil under the name of 'forcipression,' which consists simply in embracing the bleeding point or points in the blades of a catch-forceps or ordinary dressing-forceps, tying the blades of the forceps together if necessary, and leaving them in the wound till they drop off, or till the surgeon thinks it safe to remove the instrument. And this, or something like it, is often done after amputation. Obstinate bleeding from a point which cannot be fairly brought into view, or where the tissues are too rotten to bear a ligature, may frequently be suppressed by taking up all the tissues around with a tenaculum or sharp hook, under which a common or an elastic ligature is passed, and which is left in the wound for a day or two, or allowed to fall off by itself.

Capillary hæmorrhage. Pressure: cold; styptics.

Such are the surgical means for combating those formidable attacks of hæmorrhage which result from injury to the larger vessels. But the common hæmorrhage which proceeds from small arteries or capillaries and veins, when it does not cease of itself, as in the great majority of cases it does, is usually treated by one of three methods—pressure, cold, or styptic applications—and sometimes by a combination of them.

Pressure is the most effectual hæmostatic when it can be applied evenly over the whole wounded surface; in fact, we have seen above how potent it is in repressing hæmorrhage even from the femoral artery after ligature. In some cases pressure can only be applied with the finger. Thus, in a case under Sir B. Brodie's care, where the internal pudic artery had been wounded inside the ramus of the ischium, pressure was made by a relay of students for forty-eight hours successfully. But ordinarily pressure is made, as directed on p. 90, with graduated compresses, kept in position by strapping, and assisted if need be by a horse-shoe tourniquet. The limb in all cases should first be evenly and firmly bandaged.

Cold is usually applied by exposing the part to the air, as in opening bleeding abscesses (see p. 29), or in operations where a good deal of oozing is going

on and cannot be repressed. In such cases the operator passes his sutures through the edges, but does not tie them, and leaves the part exposed to the air for a few hours, when any clot which has collected may be gently removed and the stitches drawn together. The application of ice in a bladder to the wound, and the irrigation of the wound with iced water, are also powerful hæmostatics.

Of styptics the one in most use at present as a local application to wounds is the perchloride of iron. Lint steeped in the Tinct. Ferri Perchlor. is laid on the bleeding surface and gently pressed into it. Another very useful styptic, especially when it is desired to produce a superficial slough as well as to stop bleeding, is *blue lint*, i.e. lint which has been steeped in a saturated solution of sulphate of copper, and is kept at hand dry for use. Matico leaves are often used with success to fill bleeding cavities, such as those of cancerous ulcers.

Finally, the most powerful of all styptics is the actual cautery lightly used at a white heat. The shape and size of the cauteries should be adapted to the surface to which they are to be applied, so that a good many ought to be at hand at once. By far the best cautery, when it is not necessary to apply the heat to a very large surface, is the newly invented 'Benzoline cautery,' in which any required degree of heat can be produced in a moment. They should not be used too cool, otherwise the tissues are apt to stick to them, nor be pressed too hard or too long on the bleeding surface, for the same reason. If the charred tissue sticks to the cautery the parts will be torn in dragging it away, and the bleeding will most likely recur. Many surgeons think that this adherence of the tissues is less probable when the cautery is heated only to a dull red; but whatever be the method of applying the cautery, the surgeon should not be contented till he has seen that every point from which free bleeding came has been perfectly and completely charred, and then the tissue may even be returned into the interior of the body (as in piles or ovariotomy) with full security against recurrent hæmorrhage. Nor is secondary hæmorrhage at all common on the falling of the slough.

The actual cautery is also used extensively as a counter-irritant, as will be pointed out in the chapter on MINOR SURGERY.

Transfusion of blood.

In some cases of the most extreme exhaustion from hæmorrhage the patient has been rescued from death by injecting blood into the veins. This blood is taken instantly before injection from the arm of a healthy person.[1] There are two chief methods of transfusion—the indirect and the direct, or immediate. In the latter the blood is passed directly from the arm of the person who furnishes the blood into that of the patient; while in indirect transfusion the blood is received into a vessel, and may be defibrinated before it is injected into the patient's vein.

The operation is not a difficult one, if the patient's veins are well-marked. A free incision is to be made over the largest of the veins at the bend of the elbow, so as to expose it; it is then opened with a V-shaped cut of the scissors, and the nozzle of the syringe inserted. This nozzle should be warmed to the temperature of the body and filled with warm water. Then the blood is procured as rapidly as possible from a healthy man, whose vein is opened in a

[1] In America lately lamb's blood seems to have been tranfused in cases of consumption. I know nothing whatever of the practice, except from one case, in which it is spoken of with reprobation—'Boston Med. and Surg. Jour.' Jan. 14, 1875, p. 38. In the 'Med. Times,' Sept. 5, 1874, will be found a *résumé* of some experiments on transfusion from one animal to another, from the 'Centralblatt f. Chir.' of the same year.

similar way. If the immediate method is followed, after Dr. Aveling's plan, the nozzles of the two syringes are connected by a warmed tube, in the middle of which there is an elastic bulb, the capacity of which should be accurately known. The nozzles being inserted in the two veins, in the course of the circulation, the tube is fixed on to the nozzle in the blood-giver's arm, and the operation proceeds as described. The blood is injected by successive discharges of the bulb, until about 6 ozs. has been passed in. It is not generally considered necessary or desirable to inject a larger quantity at once.

I have no doubt, however, that Mons. Roussel's apparatus for transfusion is much superior to any other in use, and in fact reduces the dangers of the operation to a minimum. Instead of opening the blood-giver's vein in the same way as that of the patient, a kind of cupping-glass is applied around it after it has been made prominent by a bandage. This glass has a cylinder in its centre and in the cylinder is a lancet, which can be protruded by pressure made on a button at the top, where also is a screw for regulating the

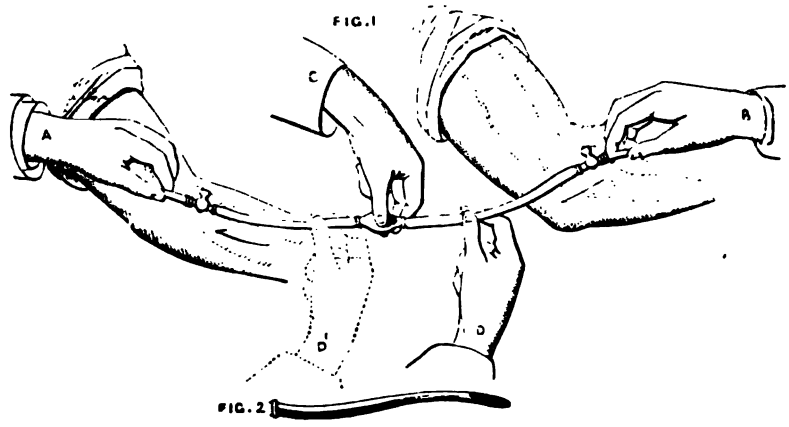


FIG. 26. Aveling's apparatus for immediate or direct transfusion. The more muscular arm on the right of the figure is the blood-giver's; the one on the left the patient's. The course of the veins is dotted down, as if the skin were transparent. B represents the hand of an assistant holding the efferent tube and the lips of the small wound together, and A shows the afferent tube secured in the same manner. The bevelled end of the afferent tube, which is made so in order that it may the more easily go into the collapsed vein of the patient, is shown in fig. 2. The nozzles having been secured in the two veins, the india-rubber portion of the apparatus, filled with water, and kept so by turning the cocks at each end of it, is now fitted into the tubes. Then the cocks are turned and the operation commenced by compressing the india-rubber tube on the efferent side, D, and squeezing the bulb C. This forces ℥ij of water into the patient's vein. Next, shift the hand D to D', and compress the tube on the afferent side. The bulb will expand slowly and draw blood in from the blood-giver's vein, which is then to be passed into the patient's; and by repeating this manœuvre as often as required any amount of blood may be injected, so long as the tube is not clogged by coagulum. See 'Obstetric Soc.'s Trans.' vol. vi. May 4, 1874.

extent of protrusion of the lancet, according to the size of the vein. The central cylinder is continuous with a tube (fig. 27) in the centre of which is an elastic bulb. This tube communicates with a vessel of warm water (6); stopcocks are fixed at each end of the tube, so as to admit or shut off the stream of water. The nozzle of the instrument having been inserted into the patient's vein, the tube is filled with warm water, the cupping-glass is exhausted and fixed to the blood-giver's arm, the vein is punctured, and blood mixes with the warm water in the tube. The stopcock (16) near the patient's arm is opened, so that at first the water, and then a mixture of water and blood, runs out into the air. When the water has all been expelled and the blood runs out pure, the stopcock is closed and the blood thus directed into the patient's vein, mixed of course at first with the small quantity of water which fills the nozzle between the stopcock and the patient's vein. Every part of the apparatus with which the blood is in contact is made of pure (non-

vulcanised) india-rubber, for according to Mons. Roussel's experience any admixture of metallic substances with the india-rubber will cause the blood to coagulate. There are, as will be seen, no valves in the part of the apparatus through which the blood flows. I will transcribe Dr. Roussel's directions for the use of his instrument.

1. Place the cupping-glass (10) over the turgid vein of the blood-giver; adjust the lancet (13); pump in tepid water.

2. Introduce the canula (17) filled with water into the anæmic vein.

3. Depress the lancet rapidly (13, 12) into the turgid vein (3); shut off the water aspirator (8); drive out through the escape canula (16) blood mingled with water.

4. Open the communication by stopcock (15) into anæmic vein, and transfuse pure blood in uninterrupted doses of 10 grammes ($\frac{1}{3}$ oz.).

5. After the transfusion of the prescribed dose place a simple bandage round the arm of each subject.

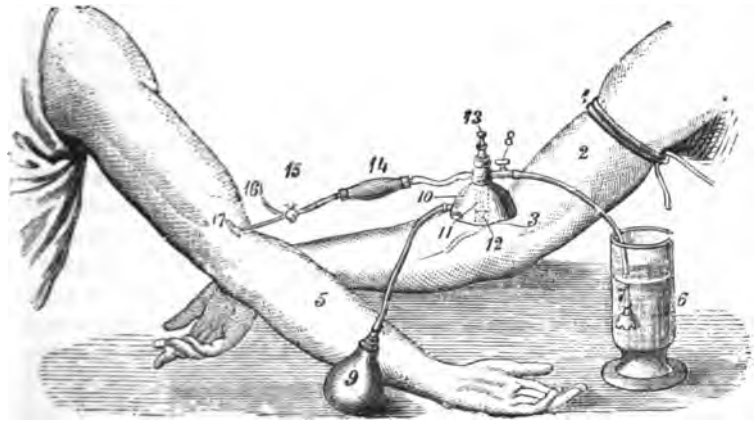


FIG. 27. Roussel's apparatus for Transfusion.

1. Bandage for bleeding.
2. Arm which supplies the blood.
3. Vein swollen for bleeding.
5. Arm which receives the blood.
6. Vessel containing water.
7. Bell of the aspirator.
8. Tap which shuts the water off.
9. Round balloon to regulate the cupping-cup.
10. External envelope of the cupping-cup.
11. Internal cylinder in the cupping cup.
12. Lancet inside the cylinder.
13. Screw which regulates the lancet.
14. Balloon pump of the transfusor.
15. Tap at the bifurcation.
16. Canula by which the water escapes.
17. Canula inserted into the patient's vein.

6. Wash the transfuser at once in warm water before the coagulation of the blood.[1]

For indirect, or mediate, transfusion numerous instruments are in use. The blood may be simply received in a warmed vessel, the fibrine rapidly whipped out of it, if the operator thinks this desirable, and the residue injected with a common anatomical injecting syringe, well-warmed; or some apparatus may be used, consisting of a bowl or cup to receive the blood, and, communicating with this, an apparatus something like a stomach-pump. But the presence of valves is very undesirable in any instrument intended for the transfusion of blood not defibrinated, since they are liable to clog; and the defibrination of the blood does not seem at all to be recommended, for it necessitates much exposure of the blood without any proved advantage. The simpler the apparatus the better; and if the instrument of Dr. Roussel, or something of the same kind, is not at hand, it would be better, I think, to use

[1] Roussel, 'On the Transfusion of Human Blood.' London, 1877.

a common anatomical syringe, taking care, of course, that it is carefully warmed to a heat of 100° before commencing the operation.

Various maladies, and especially intermittent fever, have been treated by transfusion in foreign countries (for which see the 'Medical Times,' as above), but we have no experience of the practice here, and not much encouragement from the published reports to try it.

COLLAPSE.

The condition called collapse is that of total suspension of some and extreme weakness of others of the functions of the nervous system, together with great disturbance of the circulation, from the action of some sudden cause. This cause may be mental emotion, hæmorrhage, violent injury (and especially injury of certain organs, such as the abdominal viscera, the large joints, the testicle, the mamma), severe pain, and certain poisons.

The shock may be so great as to prove fatal at once. Short of this, the state is that of 'extreme collapse,' which is thus well described by Mr. Savory:—[1]

'The patient lies in a state of utter prostration. There is a striking pallor of the whole surface, most marked from its contrast to the natural colour of the face; the lips even are quite pale and bloodless. There is a cold clammy moisture on the skin, and often distinct drops of sweat upon the brow and forehead. The countenance has a dull aspect, and appears shrunken and contracted. There is a remarkable languor in the whole expression and especially in the eye, which has lost its natural lustre, and is usually dilated. The temperature is considerably reduced, and if the person be able he will complain of feeling cold, and perhaps shudder. Muscular debility is extreme —apparent at a glance in the condition of the lips and hands; occasionally even to the relaxation of the sphincters. The pulse is generally frequent, sometimes irregular, always very feeble, perhaps quite imperceptible. In this latter case, although the ear may detect the fluttering action of the heart, the pulse does not reach the wrist. The respiratory movements are short and feeble, or panting and gasping, "wanting the relief of sighs," sometimes imperceptible; although in the majority of such cases some action of the diaphragm may be detected by careful observation. Vertigo, with dimness of vision, supervenes. As the rule, there is not complete insensibility, although there is much variability in this respect, depending no doubt on the nature of the injury; the person is drowsy and bewildered, but conscious, and perhaps rational when roused. Sometimes the intellect is singularly clear and the senses perfect; the hearing occasionally even painfully acute. In the less extreme cases there are often nausea and vomiting, with hiccup. The last is very variable in its occurrence.

'The signs of syncope are those of collapse. Travers says: "The signs of syncope and the recovery from it present an epitome of the phenomena of shock." So far as they extend, the symptoms of an ordinary fainting-fit are analogous to those of collapse. "They differ in degree and duration more than in kind." It is true that in syncope there is more uniformly a suspension of the mental faculties, as well as of the senses and voluntary powers; but this may perhaps be explained by the fact that causes which produce syncope act uniformly on the brain.

'From this extreme condition of collapse there are all possible gradations, down to a mere transient impression on the heart, pulse, and sensorium, such

[1] 'Syst. of Surg.' vol. i. p. 376, 3rd ed.

as is familiar to everyone who has ever received a severe blow or felt any great emotion.'

Reaction after collapse. 'Prostration with excitement.'

The immediate symptoms of collapse are followed by reaction, and in this stage the surgeon founds his prognosis mainly upon the rapidity of the recovery and on the character of the pulse when reaction is established. Cases in which the patient hovers long between life and death, and in which the pulse when restored is weak, rapid, and excitable ('prostration with excitement,' as Travers designated it), are very unfavourable; whilst those in which the patient, after transient collapse, recovers his senses rapidly, and in which the pulse becomes gradually more and more firm and regular, will probably terminate in recovery.

The condition of prostration with excitement is one which we have only too frequent occasion to see after great railway injuries and other frightful lesions which do not prove fatal at once. I cannot do better than again quote Mr. Savory's description of its symptoms:—[1]

'This state is marked at first by dry heat of the skin, a flushed face and anxious expression, a rapid and bounding pulse, which is sometimes even sharp, but always easily compressed. The respiration is hurried and imperfect, with partial and irregular sighs. The tongue is tremulous; there is often urgent thirst; vomiting is a frequent and sometimes most obstinate symptom; there are occasionally rigors. The languor or stupor of collapse is succeeded by restlessness, jactitation, tremor, and twitchings of the muscles, præcordial anxiety, often but not always delirium of various degrees, from occasional incoherence to wild and fierce excitement. This most frequently occurs, and is more marked, during the night. There is either an entire absence of sleep or it is partial and interrupted, and it is succeeded by no relief. As the exhaustion increases the skin becomes covered with a cold and clammy sweat, which is very often profuse. The face becomes pale and the expression haggard; the pulse innumerably rapid, irregular, fluttering: subsultus comes on; slight convulsions; coma more or less profound; and death.'

Treatment.

The treatment of collapse is naturally divided into two parts—the avoidance of immediate death in the first shock, and the treatment directed to carrying the patient through the subsequent reaction.

The first care of the surgeon when called to a case of collapse is to save the patient from the danger of instant death. For this purpose warmth is one of the most essential requisites, and especially applied to the head; towels wrung out of hot water should be bound round the head, or hot affusion sedulously employed, together with heat to the epigastrium and the extremities, while the other means of supporting animation are in practice. Galvanism over the præcordial region is a most efficacious measure. Small quantities of brandy are to be given by the mouth if the patient can swallow, and by the rectum if he cannot, and ammonia is to be applied to the nostrils. The subcutaneous injection of ether (ʒi–ʒij) is a powerful restorative. If the heart is acting, but the patient seems otherwise dead, transfusion is clearly indicated. The efforts at revival should not be hastily given up—recovery after long seeming death is not by any means rare.

Operations in collapse. Anæsthetics.

Many of the patients whom we see in the hospital practice of large cities are collapsed from grievous injuries which must call ultimately for severe operations if the patient is to have any prospect of life. In such cases the question first occurs whether to operate at once, or to postpone the operation till the patient has somewhat rallied, and with this is connected the question whether

[1] 'Syst. of Surg.' vol. i. 3rd ed. p. 378.

anæsthetics are desirable. I have seen operations performed in conditions of extreme collapse, without any manifestation of pain on the patient's part, or any apparent increase of the shock; but when the operation is a severe one, such as a large amputation, it is better, I think, to give an anæsthetic; nor is anæsthesia under these circumstances attended with danger. I have often seen the pulse improve as the patient came under the influence of the anæsthetic. Ether is, I think, preferable to chloroform in these cases, and it is well, if the patient can swallow, to give him a little alcohol first.[1] Such operations are rarely attended with any danger from hæmorrhage, and I think are best performed as soon as the surgeon believes that the patient can live through them.

Treatment of reaction.

When the danger of instant death is over the patient has still to be kept alive, a most difficult task in many of the more formidable cases. 'Stimulants alone,' as Mr. Savory says, 'may be required in the first emergency, but they soon prove useless if unaccompanied by nourishment;' and in these cases the patient's power of taking and of assimilating food is too often suspended; and we often see in cases which survive that the first effect of recovery is that the stomach rejects the fluid which has been poured into it, and which it is unable to digest, showing that the supply has been excessive, and therefore to some extent injudicious; yet the patient has been in so alarming a condition that the surgeon has believed that without stimulants and support he must die. On this subject Travers speaks as follows: 'If we neglect to supply stimulus when called for, the spark of life goes out. The signs of its indication must therefore be vigilantly observed. We are maintaining action upon inadequate power, in the hope that the natural resources may come to our relief, and that we may gradually diminish stimulus and increase nutriment, which is our only method of raising power to a balance with action. The respondence of the circulating forces to an increased supply of stimulus must serve as a caution against over-supply. Since power is deficient, we must carefully husband our only resource, and not waste it in inordinate action. When the signs of reaction are manifested, its excess is much to be apprehended if such reaction has been obtained by over-stimulation. Excessive reaction so induced is 'prostration with excitement' in its most perilous form. When such a state is the original form of the malady it is probably less dangerous, because in this case the inequality between power and action is less.'[2]

The practical rule to be deduced from these considerations is, that whilst death from collapse is imminent, the circulation must be maintained by artificial heat, galvanism, and by the administration of alcohol, but that the supply of the latter should be carefully graduated by the state of the pulse; that it should be given in small quantities as frequently as seems necessary; and that as soon as the patient can bear it small and frequently repeated doses of concentrated fluid nutriment should be given by the mouth, being preceded by similar nourishment given per rectum in such quantity as will not provoke an action of the bowel, and that the supply of alcohol should be gradually withdrawn as early as is found to be possible.

When the stage of reaction is established, if the patient passes into a condition of ordinary traumatic fever, all will probably go well. But when the stage of 'prostration with excitement' is strikingly manifested—i.e. when the

[1] Mr. R. Ellis devised an apparatus for administering the vapour of alcohol, ether, and chloroform successively, first pure and then mixed. I used this method in a case of double amputation at the shoulder and near the hip for severe railway injury, and the patient's pulse was certainly better after than before the operation.

[2] 'Syst. of Surg.' 3rd ed. vol. i. p. 384, from Travers, 'On Constitutional Irritation.'

weakness of the pulse is as striking as its rapidity, when the temperature does not rise in correspondence to the rise of the pulse-rate, when the stomach rejects all or most that is put into it, and the patient is sleepless, restless, and more or less delirious—then, as Mr. Savory says, 'the indications of treatment are clear and simple enough, but unhappily most difficult to fulfil: to support and increase power, and to moderate and reduce action.' The patient will not survive if worn out by restlessness, which must therefore be combated by morphia injected subcutaneously, or by chloral or opium in full doses, if the stomach will bear it. Mr. Savory speaks highly of the virtues of henbane in such cases in combination with opium, if the latter drug can be tolerated. The warmth of the body and extremities must of course be sedulously maintained, and the most diligent nursing must be procured, so that the patient may not be exhausted by an unfulfilled craving or by an unnecessary exertion. The irritability of the stomach must be lessened by the application of mustard poultices, by sucking small morsels of ice constantly, and by the administration of dilute hydrocyanic acid, three or four minims in a small quantity of some vehicle, or creasote mij. in pil. every three hours. At the same time both food and stimulants must be supplied, and must be assimilated if the patient is to be kept alive; and there lies the difficulty, which can only be met by giving the food in the most grateful and most nourishing form, in small quantities very often repeated, and the stimulant (which ought not to be more than is absolutely necessary) in varied kinds, according to the patient's tastes and habits, and with similar precautions as to the quantity and repetition.

CHAPTER V.

BURNS AND SCALDS.

BURNS and scalds are the most commonly fatal of all injuries, especially in cold climates, and among the poor, whose children are frequently left for long periods in the neighbourhood of fires and kettles with no proper attendance. Scalds are, as a rule, less fatal than burns, since the hot liquid is soon shaken off the body, and itself soon cools; but there are accidents somewhat resembling scalds, produced by the contact of molten metal, which are even more fatal than an ordinary burn, because the molten mass adheres to the charred parts and retains its heat for a long period.

Dupuytren's classification of burns.

The fatality of burns varies according to their extent, their depth, the part burnt, and the age of the patient, besides a number of other miscellaneous circumstances. The classification of burns according to their depth, which is usually followed, is that proposed long ago by Dupuytren, and it is no doubt a very useful and practical one, though it only indicates the depth of the burn at its deepest part; and it must be recollected that a large superficial burn may be even more dangerous than a small deep one, particularly if the latter is situated on an unimportant part. But deep burns must be followed by cicatrisation and deformity, which is not the case where the whole of the thickness of the skin is not destroyed.

The *first* degree of burns is a mere scorch, where only superficial redness is produced but the epidermis is not separated from the true skin. The scorched epidermis will desquamate afterwards, but beyond a little temporary discolouration no trace of the injury will remain.

In the *second* degree the epidermis is raised up from the cutis in blisters or bullæ, which are produced by the effusion of serum from the vessels of the papillæ, showing that the cutis itself is scorched. If the epidermis is dragged off accidentally, as happens often in removing the clothes, this scorched part of the skin will inflame, and an angry sore will result.

In the *third* degree the cutis is not only scorched but is disorganised by the burn, though not in its whole thickness. A part of the skin (viz. the papillæ and a portion of the thickness of the corium) is charred and dead, and this part must separate as a slough, exposing a granulating surface of cutis below, which heals by cicatrisation, but without any contraction, since the deeper layer of the skin which is not destroyed maintains the shape of the parts.

In the *fourth* degree the whole skin is burnt, and the subcutaneous tissue of course shares to some extent in the destruction; consequently, the cicatrisation which follows on the separation of the eschar must involve a very strong tendency to contraction, as the elastic cellular tissue is replaced by the inelastic contractile scar.

In the *fifth* degree the destruction extends below the fascia, and the muscles and other subjacent parts are burnt to a variable depth.

In the *sixth* degree the whole of the limb is charred and consumed down to the bone.

Thus the first degree of burn involves no necessary deformity, the second

and third only a scar, which remains during life, but without any change in the shape of the parts; while the deeper burns are accompanied by a tendency to contraction and deformity which can only be averted by very great care in applying extension and counter-extension while the surface is healing, and as this is frequently impossible (since the part where counter-extension should be applied may itself be burnt), deformity often ensues, and that to a very lamentable degree.

Symptoms and stages of burns.

Burns are attended with great pain; and when they are more than mere local injuries they are followed by prostration or total collapse, the temperature falls, the pulse becomes small or imperceptible, the tongue and mouth are dry; the patient is delirious, and rigors take place in the severer cases. This is the first stage, or that of collapse, prostration, or congestion; and in this stage many cases prove fatal, particularly in early childhood, death being sometimes preceded by convulsions. No post-mortem appearances will be found, except congestion of various viscera, particularly the brain—the result apparently of revulsion of the blood from the surface.

The next stage is that of reaction or of inflammation. It may be said (very roughly) to follow the first after an interval of about two days. The burnt surface begins to suppurate, usually with a very offensive odour, the pulse rises in force and frequency, and there may be some amount of general fever. The various internal inflammations which may be set up by the proximity of the burn to the great cavities of the body now begin to declare themselves, pleurisy and peritonitis being the most frequent. The signs of such internal inflammation are usually obscure at first, especially as physical examination is generally impossible. Disturbances of the digestive system, such as constipation, followed by diarrhœa or obstinate vomiting, are common in this stage of burns.[1] These symptoms may be caused by incipient peritonitis, or, as it seems, by the foulness of the discharge. As the sloughs separate hæmorrhage may take place, but it is very rare. In fatal cases various inflammatory appearances are found, chiefly of the thoracic and abdominal viscera, for the brain is rarely inflamed in burns even of the scalp. Amongst these must be noted the inflammation and ulceration of the mucous membrane of the intestines which sometimes takes place. It is usually limited to the duodenum, though the stomach, or the rest of the small intestine, may be also affected, or may even be ulcerated in cases in which the duodenum is intact. The subject of ulceration of the duodenum will be resumed with the third period, in which it is perhaps most common.

The third period, that of suppuration and exhaustion, is held to commence about a fortnight after the accident, or else is said to begin after the sloughs have separated. The acute symptoms which may have followed the injury will have subsided, but chronic inflammation is not by any means uncommon, and is often the chief cause of death. The patient becomes gradually weaker and weaker, and in this stage he often succumbs, perhaps after exhausting diarrhœa, which is sometimes accompanied by blood in the motions. Post-mortem examination may show no definite visceral lesion, or low inflammation of the lungs, pleura, peritoneum, or intestines may have been present. The duodenum may be found ulcerated; and in this, as in every other injury, pyæmia or erysipelas may be the direct cause of death; but neither is re-

[1] Dr. Morton, in the American reprint of the 2nd ed. of the 'System of Surgery,' says that congestion of the kidneys and albumen in the urine almost always occur as soon as reaction sets in and the temperature rises above 101° F.

latively common in burns. Tetanus, again, sometimes follows the irritation of a burn.

Ulceration of the duodenum in burns.

The ulceration of the duodenum is a singular and hitherto unexplained sequela of burns.[1] As stated above, the ulcerative action is not absolutely limited to the duodenum, but the instances of its occurrence in other parts of the intestine are purely exceptional. It is not necessarily fatal, for cicatrised ulcers have been found in the duodenum where death has occurred from other causes.[2] It occurs at different periods after the burn, the earliest hitherto recorded being four days; but it is rarely so early, and is more common after than before the first fortnight. It occurs after burns of the extremities as well as those of the chest and abdomen. It is found in a tolerably large proportion of fatal cases (in 125 post-mortem examinations 16 presented this lesion), and may very possibly be present in many of those which recover. The lesion is not known to be accompanied by any definite symptoms in its early stage. Pain on pressure near the pit of the stomach, and diarrhœa, with blood in the motions, naturally arouse a suspicion of this ulceration, and vomiting is not unlikely to be an accompaniment of it; but there are many other ways in which pain and tenderness of the stomach, vomiting and diarrhœa, may occur in burns, and even some blood may be passed in the motions without any breach of surface; obstinate diarrhœa, however, and copious loss of blood would point strongly to ulceration. When the lesion proves fatal it is either by hæmorrhage or by perforation through the coats of the bowel into the peritoneal cavity. The accompanying illustration shows a large artery, the pancreatico-duodenalis superior, laid open by an ulcer of this kind; and our museums contain plenty of specimens of perforation. The ulcer is generally single, cleanly punched out of the mucous membrane, and situated close to the pylorus.

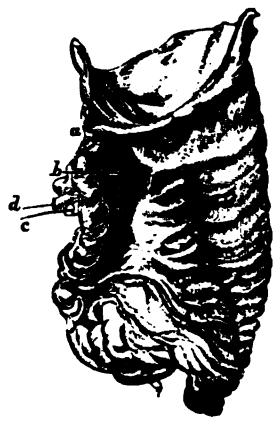


FIG. 28. Ulceration of the duodenum in a burn, causing death by hæmorrhage from a large branch of the pancreatico-duodenalis artery. *a*. The pyloris. *b*. The ulcer on the duodenum, close below the pyloris. *c*, *d*. Bristles passed through the artery and vein, which are seen to open freely on the ulcer.—From 'Syst. of Surg.' vol. i. p. 395, 3rd ed.

Burn and scald of the larynx.

I have purposely abstained here from any reference to a very common cause of death in burns and scalds—viz. the injury which is so often done to the larynx by inhaling flame, steam, or hot fluid—thinking it better to treat the subject along with the other injuries of the air-passages (see the chapter on INJURIES OF THE NECK); but the subject is one which should never be absent from the surgeon's mind. The mouth and pharynx should be closely inspected, if it can be done without difficulty, in every case where the burn or scald is at all near the lips. If this cannot be managed without too much disturbance to the patient, a good idea of the immunity or implication of the interior of the mouth will be obtained by watching the patient swallowing and breathing, and every precaution should be taken to have

[1] The explanation given, that the destruction of the sweat-glands of the skin throws a strain on Brünner's glands, which are then charged with the office of separating watery elements from the blood, seems to me more ingenious than probable. The traces of irritation are not confined to Brünner's glands, for the solitary glands of the rest of the intestines are sometimes found enlarged; and there is no proof that either Brünner's or the other glands are capable of any such vicarious office as is here assigned to them, nor is the transition from such unnatural activity to inflammation and perforating ulceration at all obvious.

[2] 'Syst. of Surg.' 3rd ed. vol. i. p. 395.

help promptly at hand in any case which may be likely to require tracheotomy. If the mouth be much burnt it may be right to feed the patient through the nose, and to eke out the support and stimulants which can be given through the pharynx by nutrient injections into the rectum.

Local treatment.

The treatment of burns is directed—1. To the immediate lesion; and, 2, to its after-consequences. At the time of the accident the main indications are to exclude the air from the burnt surface, to allay pain by opiates, and to give stimulants in such quantities as may be necessary. The applications which are in use for burns are too numerous to mention, and the choice of one or other of them will depend in a great measure on the depth of the burn. A mere superficial scorch is best treated by some warm lotion applied on a thick rag and kept constantly moist. Goulard-water with a little laudanum is perhaps as grateful as anything. Painting the surface with ink soon relieves the pain of a small superficial burn, or covering it with whitewash or some other similar substance which will crust over it and completely exclude the air from it. Common flour thickly dredged on the part is a very good and handy application. But such crusts should not be applied over burnt surfaces of the second degree, since their removal would soon become necessary, and this would drag off the epidermis. The bullæ should be pricked, the epidermis gently smoothed down, and some simple ointment put next the skin or some oily substance which will not stick when it is necessary to change it. A very favourite application to these burns and to others of greater depth is the Carron oil, made by mixing lime-water and linseed-oil in equal parts, and deriving its name from its having come into extensive use at the great Carron Foundry in the numerous burns occurring there. Oil of turpentine is a very good application to those in which the surface of the skin is quite destroyed. But for the first few days I doubt whether anything is better than simply swathing the part in thick layers of cotton-wool, which is prevented from sticking to the burnt surface by some simple ointment (Cerat. Calaminæ is generally used) spread on thin soft linen or cambric, and covering the whole burnt surface. When after a few days the discharge becomes foul, this dressing should be changed for some deodorising or antiseptic oily application, or the latter may be used from the first; but all the antiseptics I have yet seen used have been stimulating, and for the first few days it is desirable, I think, to avoid any local stimulation. The carbolised oil answers every indication better than any other substance which I know of, but it should not be used too strong; for it may both prove too stimulating, and thus increase the discharge, and it may be absorbed, producing a black condition of the urine [1] and other symptoms of incipient poisoning. It is well, then, to begin with a very weak solution (about 1 to 12), and if this does not correct the fœtor its strength may be gradually increased, or a stronger solution of carbolic acid may be placed over the dressings. If carbolic acid is not tolerated, some preparation of benzoin or Condy's solution, or the Lot. Sodæ Chlorinatæ may be applied either directly to the burnt surface or over the dressings. As the sloughs separate they should be removed at once, and any part of the slough which hangs loose should be cut away, so that the fœtor may be diminished as soon and as much as possible. It is, in fact, to the foul air which fills the sick-room that many surgeons with much reason attribute a great share in producing the mortality of the latter stage of burns. It keeps the patient in a low condition, destroys his appetite, and very probably keeps up or produces diarrhœa. And in hospitals it often poisons the whole air, not only of the

[1] See 'St. George's Hospital Reports,' vol. vi. p. 98.

ward itself, but of all the parts of the house which communicate with it. Hence the importance of remedying it in all possible ways. So long as there are offensive burns in a sick chamber or hospital ward the atmosphere may be partially sweetened by carbolic acid, by burning cascarilla bark, or by exposing chips of iodine or by diffusing Condy's solution or other deodorising fluids in the pulverised condition about the room, but it cannot be doubted that some mephitic gases will still remain uncorrected. After all sloughs have come away the patient has still to undergo all the troubles incident to a long cicatrisation and often the filling up of a deep cavity. The greatest care should now be bestowed to keep the parts in such a position as to obviate contraction if possible; and the recent happy invention of skin-grafting has provided us with a means of hastening the process of healing when tardy and of providing the materials of a scar when the surface is too extensive to fill up naturally, which is of the greatest utility in burns (see the section on SKIN-GRAFTING).

General treatment.

At the time of the accident opium should be liberally given to adults, and even in the case of children it is usually necessary, though more caution should be used; or it may be thought desirable to administer chloroform for the removal of the clothes and the first dressing, and to keep up partial insensibility by injecting morphia subcutaneously before the patient has quite recovered from the anæsthesia. Stimulants must also be given if there is much collapse, but they should not be poured down indiscriminately, for the administration of an excessive quantity of alcohol is always followed by reaction and renewed prostration; the pulse must be carefully watched, and only so much brandy or wine given as is required to keep it at a moderate rate and strength. If the patient can take food in good quantity this is a better source of warmth and power, and the power of assimilating food affords a good augury of recovery. If the patient be a child convulsions are to be dreaded, and are a frequent cause of death. They appear to depend on, or to be connected with, congestion of the brain, and are therefore better treated by warmth to the surface than by any other plan. The warm bath being here inadmissible, warm affusion to the head, or cloths wrung out of hot water, should be tried. Diarrhœa must be treated by opium, or by calomel and opium, or by a starch and laudanum enema, the air being changed as often as possible, if foul. Vomiting is to be controlled if possible by prussic acid or by creasote. It is, however, of the last importance in severe cases of burns not to exhaust the patient's strength needlessly by too frequent changes of dressing, and this is still more important in childhood, when terror and screaming add to the exhaustion which is necessarily caused by the pain and the change of posture, besides probably causing some bleeding from the granulations. So that burns ought never to be dressed too frequently; and the surgeon has often great difficulty in steering his way between these contrary indications, since if he puts off the renewal of the dressing too long the foulness of the atmosphere becomes a source of danger.

Amputation in burns.

Finally, it may become a question in some cases whether amputation is desirable. This question occurs commonly only in the case of single fingers or toes, or of parts of the foot. It is but rarely that anything is gained by amputation, for the parts around the burn for some distance are sure to be more or less injured and prone to inflammation, so that the surgeon could not get materials for a healthy stump without going too high above the seat of injury; and burns so severe as to disintegrate a large portion of the limb are attended with an amount of prostration which forbids amputation, at least at the time. After the patient has rallied the surgeon may think it better to

relieve him of a member which can only be a useless incumbrance, but such cases must be conducted on the same general principles as those which are applicable to secondary amputation for other kinds of injury.

When recovery has been completed and the surface has cicatrised, great deformity is often left, requiring plastic operation, or gradual extension, or some other proceeding by which the parts may be restored to their normal appearance and function as far as may be possible. But I think it better to reserve this topic for discussion, under the head of PLASTIC SURGERY, in a future chapter. Plastic operations.

LIGHTNING-STROKE.

A stroke of lightning produces injuries which are the combined effect of electric shock, mechanical concussion, and burn. The symptoms vary from instant death to a very trivial amount of shock. The effects are very various. The surface of the body may be burnt more or less severely;[1] it may, as is said, be marked by arborescent lines, which are believed to be in a sort of way photographed from neighbouring trees or other objects; the hairs may be removed or fall out soon afterwards; the special senses, especially that of sight, may be more or less impaired or even totally destroyed; the other functions of the brain may be variously affected, sometimes to the extent of total paralysis; and other less definite and less certain effects have been described.

In cases of sudden death from lightning it appears that the muscles are usually made rigid at once, though this rigor is sometimes so transient that some writers, notably John Hunter, teach that there is no rigor mortis in such cases; but the amount and duration of rigor vary. In some cases there is excessive and long-continued stiffness, the blood is often uncoagulated, and the heart flaccid and empty.

The indications for surgical treatment in cases of apparent death from lightning are thus given by Brodie:[2] 'Expose the body to a moderate warmth, so as to prevent the loss of animal heat, to which it is always liable when the functions of the brain are suspended or impaired; and inflate the lungs, so as to imitate the natural respiration as nearly as possible.'

The minor injuries must be treated on general principles. Galvanism appears the most appropriate remedy for any partial loss of cerebral power, and should be used in a mild form for a very long time, combined with small doses of strychnia and other tonics. It has often been noticed that success has attended this treatment, when long persevered in, even in cases where the special senses had at first been very seriously impaired.

[1] A very singular case is described in 'Clin. Soc. Trans.' vol. xiii. p. 32, by Mr. Wilks, of Ashford, in which a man was literally stripped naked (except one sleeve of his flannel waistcoat) by a flash of lightning, which also burned and otherwise injured him. He ultimately recovered.

[2] Works, edited by Charles Hawkins, vol. i. p. 442.

CHAPTER VI.

GENERAL PATHOLOGY OF FRACTURES AND DISLOCATIONS, INCLUDING THE PROCESS OF UNION IN HARD PARTS.

FRACTURES.

A FRACTURE is defined as being a sudden and violent solution of continuity in a bone. The force which produces it (its immediate cause) is generally external, though in some cases muscular action causes fracture. Occasionally disease of the bones acts as a predisposing cause of fracture, such diseases being rickets, senile atrophy, cancer, mollities ossium, necrosis, strumous or syphilitic inflammation, and locomotor ataxy according to Charcot.[1]

Intra-uterine fracture.

Fractures occur at all periods of life, but are of course more common at the periods of greatest activity, and in the male sex. They occur even within the uterus, whether from external violence, as from a fall or blow experienced by the mother, or from the contraction of the uterus. In the latter case they are often multiple, and the bones of the fœtus are diseased (congenital rickets). Fractures also take place in healthy infants from violence in delivery.

Classification—simple and compound fracture.

Fractures are always divided by English authors into *simple*, which do not communicate with the external air; and *compound*, which are exposed to the air through a wound in the soft parts; and the distinction is an important one, since, as a rule, the two kinds of fractures involve a very different amount of danger, and unite in a very different manner.

Fractures are also divided, according to the nature of the separation, into single, multiple, incomplete, and complicated, and these are again subdivided.

Transverse, oblique, and dentated fracture.

Thus single fractures may be *transverse*, *oblique*, or *dentated*. It may be true, as stated by Malgaigne, that the fractures of long bones are never truly transverse, yet the distinction is very important in practice between a fracture which runs in a tolerably transverse direction and one which is perceptibly oblique, since the latter is so much more liable to displacement than the former. The terms explain themselves, but good examples of each form of fracture will be found in some of the illustrations in the sequel. Transverse fracture is best illustrated by the common fracture of the patella (q. v.) A good specimen of oblique fracture is figured in the section on fractures of the lower end of the femur.



FIG. 29. Incomplete or 'green-stick' fracture of the clavicle, from a preparation (Ser. i. No. 76) in the Museum of St. George's Hospital ('Syst. of Surg.' 3rd ed. vol. i. p. 410).

To these classes of single fractures separations of the epiphyses should be added—they will be further treated of below.

Splintered and comminuted fractures.

Multiple fractures are those in which the same bone is broken in two or more different parts of the limb, or in which there are fractures of two or

[1] See Jacobson, 'Syst. of Surg.' 3rd ed. vol. i. p. 405.

more different bones; or, in which, along with a complete fracture, a splinter has been separated from the rest of the bone ('splintered fracture'), or in which there are several lines of fracture comminuting the bone, i.e. separating one or several large portions from it ('comminuted').



Fig. 29. A preparation, in St. George's Hospital Museum (Ser. i. No. 137), showing the lower epiphyses of the femur and tibia and both epiphyses of the fibula separated in the same injury. From Holmes's 'Surg. Diseases of Childhood.'

Incomplete and green-stick fractures.

Incomplete fractures are either simple *fissures*, very common in the flat bones, such as the skull, and seen, though rarely, in the bones of the limbs,[1] or *bending* of the bone, which is usually the result of *greenstick-fracture*, i.e. of fracture of a portion of the fibres of the bone, while the remainder are unbroken (fig. 29), such as occurs when a soft bough is bent;[2] or *perforations*, though these are better described as wounds of bone, or *splintering*, when a small piece only is detached from the bone, its continuity as a whole being uninterrupted. The bone itself may be entirely fractured, but the periosteum may remain untorn, and this seems more common in fractures of the ribs than in any other bone.

Complicated fractures are those in which a joint or some neighbouring cavity is injured (as the pleura in fractured ribs), or when there is lesion of some large vessel, or a wound not exposing the fracture.

Fat-embolism.

A curious complication of fractures and some other injuries has lately been described in Germany, and deserves notice here, though its reality can hardly be said as yet to be definitely established. I mean *fat-embolism*. The marrow of the bone being crushed by the fracture, it is believed that some of the free fat may pass into the veins, and so being detained in the capillaries of the lungs produce death by interference with respiration, or may be detained in other viscera. This condition is said also to have been noticed after gunshot and other wounds and possibly in some other conditions of disease, but its symptoms are hardly as yet defined. As it was described originally from pyæmic cases, it was at first believed to be a very fatal complication; but this seems very

[1] These longitudinal fissures in the long bones may, perhaps, be more common than is generally believed. The museum of St. George's Hospital contains a curious specimen of a child's tibia showing a fissure extending longitudinally down the bone, and presenting in quite a different part of the front and back surface. Mr. H. Morris has given an interesting account, partly after M. Féré, of longitudinal and spiral fractures of the femur and tibia ('Syst. of Surg.' 3rd ed. vol. i. pp. 1021 and 1043), and I have met with cases in practice suspected to be of this nature, in which the long uselessness and painfulness of the limb after severe injury, unaccompanied by any of the usual signs of complete fracture, gave support to the diagnosis.

[2] Bending is believed sometimes to occur in the skulls of infants without the rupture of any of the bony fibres.

dubious. I must refer the reader who wishes to know more of this subject to Mr. Jacobson's account of it in the 'System of Surgery,' 3rd ed. i. 426–7.

Separations of epiphyses.

Separations of the epiphyses (fig. 80) are injuries which it is frequently difficult, sometimes impossible, to distinguish from fracture; in fact, pure separation of the epiphysis occurs very rarely, for in the injuries which are so denominated the fracture usually involves the shaft to some extent, as well as the epiphysial cartilage.[1] In a pure separation of the epiphysis (i.e. where the line of the fracture runs through the cartilage only, and does not trench on the bony tissue either of the shaft or the epiphysis) it is presumable that there would not be the true bony crepitus, though there might be some analogous, but less distinct, sensation. Where the line of junction is broad, as in the upper end of the humerus or lower end of the femur, there will be no shortening, but the lower fragment will most likely project.[2] If the line of junction be within a joint, swelling of the joint will take place. The nature of the accident will then be marked by the loss of power following injury in a patient of appropriate age, the position of the displacement, the mobility of the epiphysial fragment (which, however, cannot always be ascertained), and possibly by the character of the crepitus, with the symptoms of injury to the joint. The treatment must be the same as for fracture. The chief importance of the subject is that such injuries are sometimes followed by suspended growth of the bone, producing deformity, apparently as the result of degeneration of the epiphysial cartilage after the injury, whereby it loses its powers of ossification. Further remarks on these injuries will be found under the heads of fracture of the various bones.

Diagnosis between separation of the epiphyses and ordinary fracture.

Symptoms of fracture.

The symptoms of fracture are divided into the *rational* and the *sensual*. The former are inferential only, and are given either by the lesion which the fracture produces, such as the injury to neighbouring viscera (of much importance in the chest, head, and pelvis), or by the loss of power caused by the fracture.

The *sensual* symptoms are further divided into those which are equivocal, such as pain, swelling, and ecchymosis; and those which are unequivocal, the latter being (*a*) the crack heard or felt by the patient at the time of the accident, which, for obvious reasons, is not commonly observed; (*b*) the unnatural mobility of the fragments, which, however, is absent when the fragments are *impacted*, i.e. one fragment driven into the substance of the other,[3] and in all fractures of the skull, most of those of the ribs and pelvis, besides many others; (*c*) the deformity or displacement: which is decisive in all cases where it exists, but it is, of course, very often absent. The displacement of fractures is divided, for purposes of description, into (1) lateral or transverse, when the fragments lie more or less by the side of each other; (2) shortening, or riding, or vertical displacement, when the lower fragment ascends above the lower end of the upper; (3) angular displacement, when one or both deviate from the axis of the limb; (4) rotation, when one or both are twisted on their own axis; and (5) absolute separation. It will be obvious that all the forms of displacement may be variously combined. Displacement is produced by the

Crack.

Mobility—impacted fracture.

Displacement.

[1] See Holmes, 'Dis. of Childhood,' 2nd ed. p. 238, note.

[2] See a figure in the section on fractures of the upper end of the humerus.

[3] Characteristic illustrations of impacted fracture are furnished by the extra-capsular fracture of the cervix femoris. See the section on that subject.

action of the original violence, aided in some cases by the weight of the body, or by subsequent violence or by muscular action. (*d*) The last and the most important of the sensual symptoms of fracture is the crepitus, or the crackling sensation and sound produced by rubbing the two fragments on each other. This crepitus is the sign commonly looked for, and when found is usually decisive of the nature of the injury; but it is not always present, and in some exceptional cases its presence is not decisive of the existence of fracture. It is a grating sensation which a little practice soon makes familiar and unmistakable to the surgeon; but, as it is produced by rubbing the fractured ends on each other, it cannot be felt when these are immovable, as in all firmly impacted and many dentated fractures, or when the fragments are not in apposition, as when they ride on each other (though in this case and in some cases of impaction they may be brought into apposition or made movable by extension), or are entirely separated, as in many cases of fractured patella; and in some cases where one of two bones of a limb is broken, and the sound bone prevents any movement being impressed on the broken fragments of the other. It seems also that pieces of fascia, muscles or bloodclot may get between the fragments and prevent crepitus. Taken altogether, however, it may be said that such cases are exceptional, and that in most of them the presence of fracture may be made out by the other signs. Crepitus may be present in cases where there is no fracture. Effusion into the sheaths of tendons or into the cavity of a joint will produce a sensation much resembling crepitus. Effusion round the dislocated head of a bone sometimes leads to a crepitus which very closely simulates that of fracture; and caries of the joint-surfaces is accompanied by a crepitus under passive motion which is identical with that of broken bone. So that cases do occur in which dislocation with considerable swelling, or a contusion or sprain of a diseased joint, is accompanied with crepitus, like that of fracture. But such cases can be distinguished by careful examination, especially with the aid of anæsthesia. It may be occasionally impossible to be quite certain of the absence of fracture in cases of severe contusion and in injuries of the chest, but in such instances it is more prudent to treat the case as a fracture. In injuries of the head also it is impossible to affirm the absence of a simple fracture without displacement. But the point is one of little moment. Thus it may be confidently stated that fractures constituting substantial injuries are usually easy to diagnose.

Crepitus.

Diagnosis of fracture.

The general indications of treatment are very simple, but the method of carrying them out in practice can only be understood by studying each fracture separately. These general indications are: (1) to reduce or 'set' the fracture, i.e. to place both fragments in the position which they occupied before the accident; (2) to maintain the fractured ends in position for a period which experience shows to be sufficient to avoid further displacement, and which varies for different fractures and at different ages; (3) to counteract unfavourable symptoms and complications.

Treatment. General indications.

1. A patient known or suspected to have received a fracture ought to be conveyed home with all possible care, having the limb defended by some temporary contrivance from all risk of further movement, whereby many simple fractures are made compound. For this purpose pieces of thin board or of sticks or of pasteboard may be used, with such impromptu bandages as can easily be made out of the clothes. He should be placed in bed (in cases at any rate of fracture of the lower limbs) before any serious examination is made, and the clothes carefully cut off the injured limb. Then, in order to reduce the displacement, its nature should first be carefully ascertained, and steady

Setting the fracture.

gradual *extension* made in the appropriate direction by the surgeon, or, if necessary, by an assistant. Another assistant makes *counter-extension*, i.e. steadies and fixes the other part of the limb and body so that the extending force acts on the lower fragment only. When by these means the proper length is restored a little judicious manipulation will remedy any angular, lateral, or rotatory displacement. In impacted fracture more powerful extension may be required in order to disengage the fragments and restore the length of the limb, for which purpose an anæsthetic is to be given. But the violence necessary to disengage an impacted fracture often produces disastrous consequences, and in most cases the patient will be well advised to submit to the deformity which must ensue rather than run the risks incidental to violent extension.

In setting a compound fracture there is often great difficulty from the protruding fragment being tightly girt by the skin and other parts, or from the irregular projection and interlocking of comminuted fragments. It must be remembered that there are two ways in which a fracture may be made compound, which are best illustrated by fractures of the leg. In one case a cart-wheel may have passed over the limb, crushing and tearing the soft parts off the bone at the same time that the latter is fractured. In this case there will most likely be a large wound, giving free access to the fragments which are not likely to be embraced by the wound, though comminuted portions may require removal or replacement before they can be accurately adjusted. In another case a man receives a simple fracture, and in his efforts to raise himself or in other muscular efforts he drives one fragment (generally the upper) through the skin. The fragment often protrudes to a great distance, and is tightly grasped by the skin; but the wound is much smaller, and less contused, and the chance of its rapid union much greater. Whenever there is any difficulty in the reduction of a compound fracture an anæsthetic should be administered, and the cause of the difficulty carefully ascertained. If it be the small size of the wound probably a free division of the skin will enable the surgeon to reduce the fragment, otherwise the latter must be sawn or clipped away. If comminuted portions interpose they may be occasionally pushed aside; but as they are generally much loosened from the soft parts it is better to take them away. If portions of muscles or fasciæ are wedged in between the bones they can be drawn aside with a blunt hook or director. When the fracture is fairly set it must be put up so as to leave the wound exposed, in order that the dressings may be applied without disturbing the fracture, and it is often advisable to make a counter-opening and pass a drainage-tube through the wound and this counter-opening, in order to keep the seat of the fracture free from blood and other decomposable matters. This end is effectually secured by periodical syringing through the drainage-tube.

Amputation.

Amputation is required in cases where the main arteries, nerves, or joints are also injured, or where the laceration of the soft parts is so great that gangrene is inevitable. But the indications for amputation differ much in the lower and upper limb. Thus, in compound fractures laying open the knee-joint, amputation is usually (though by no means always) necessary in the adult; while, in compound fractures of the elbow and shoulder, amputation is only performed in exceptional cases; and similarly with injuries to the vessels or nerves, the surgeon is much more disposed to recommend amputation in the lower than in the upper limb; and in all cases injuries which in the adult are a decided motive for amputation may be brought to a perfectly successful issue in a healthy child without any operative interference.

2. When the fracture has been reduced the next care of the surgeon is to maintain reduction. The general nature of the apparatus used for this purpose need alone be treated of in this place, since the special contrivances applicable to each form of fracture will be described with each. Apparatus to maintain reduction—splints.

Fractures communicating with the cavities of the head and trunk, as a rule, require no special apparatus. In fractured ribs, and sometimes in fractured pelvis, a bandage is applied to maintain the parts at rest; but even this is often found unnecessary.

In the extremities, however, some firmer basis is usually required, in order to maintain the extension, and to prevent accidental displacement. This is provided by *splints*, i.e. pieces of wood or metal, or of some malleable compound such as pasteboard, adapted to the size and shape of the limb, embracing it more or less completely, and fixed on by bandages, webbing-straps, or otherwise, so as to keep the fractured ends as accurately as possible in position, and immovable, during the whole time of treatment. Many of these apparatus will be found figured or described in the sequel, under the head of the Special Fractures; and I do not know that it is worth while to give any general description beyond what is to be found in the chapter on MINOR SURGERY as to the art of splint-making. Its main principles, however, can hardly be too often recapitulated. They are these: the splints should fit the limb as evenly as possible, extending as far on either side of the fractured part as is necessary to keep the fracture quiet, without limiting the movement of the neighbouring joints, unless, indeed, it is necessary, with a view of obviating displacement of the fractured bones, to include the joint in immediate contiguity to the fracture, and this is very often the case. The splints should not be so applied as to impede the return of blood from the limb and produce œdema, still less so as to oppose the supply of blood, by which gangrene and the loss of the limb has sometimes been caused. The splints must not press anywhere on the soft parts so sharply as to cause ulceration.

Another form of retentive apparatus is the *junk*. It is used only in fractures of the lower extremity. Its name is derived from *juncus*, a reed; and it used to be formed of a piece of thick cane or reed (for which a stick is now substituted) sewn into each side of a square piece of cloth. The leg is wrapped in a thin pillow (the 'junk-pillow') after the fracture has been set, and the whole is steadied by being encircled in the junk, which prevents any lateral or vertical displacement. The angular displacement which might result from the toes dropping, and thus projecting the upper end of the lower fragment forwards, is obviated by bandaging the foot at right angles. Junks.

Hyponarthetic apparatus, or fracture-boxes, as they are more familiarly termed, are troughs in which the limb is fixed by various contrivances of straps, bandages, &c., screwed to the framework, so that the limb is maintained in the precise position in which it has been placed after extension. The trough is often formed of two pieces jointed together, so as to keep up extension by means of a rack and pinion. Hyponarthetic apparatus.

The usual means of maintaining a permanent extending force by which the lower fragment may be drawn away from the upper, is by means of a weight and pulley passing over the end of the bed, as is commonly done now in disease of the hip, and which will be found delineated in the section on that subject. This plan is much in use in America, I believe, in fracture of the femur; but in England it is used chiefly as an adjunct to the splints. Extension apparatus.

One of the most painful and distressing features in the ordinary treatment of fracture of the lower extremity, when the limb is kept immovable on the Swings.

bed, is that this immobility prevents the patient from making any but the most restricted movements of the rest of the body. Hence the invention of the *swing*, of which the kind now in almost universal use for the lower extremity is that devised by Mr. Salter, which will be found described in the section on Fracture of the Leg. Injuries of the arm and excisions of the elbow are often treated with great comfort to the patient by swinging the arm by means of a pulley from a pole projecting over the bed or from the bedstead (see Excision of the Elbow).

Treatment of complications.

8. After the fracture has been set and put up, the only thing necessary is to keep watch for, and counteract, any complication which may ensue. In cases of simple fracture these are commonly few and trivial, so that these fractures are hardly ever dangerous to life, and with moderate care are usually brought to unite without serious deformity. The chief points are: to see that the displacement is not reproduced, through slipping or imperfection of the apparatus, and to that end to renew the measurement, and, if possible, examine the seat of fracture from time to time—say every week; to combat the painful spasms which sometimes attack fractures, for which purpose equable pressure, as by careful bandaging or strapping, is the most efficient treatment; to relieve the neuralgic pain which is occasionally very distressing, by blisters dusted with opium, or morphia, by hypodermic injections, and by the usual remedies for neuralgia; to treat the very distressing itching which sometimes attacks the skin by sedative ointments or lotions; and to open abscesses, should any unfortunately form, as early as necessary.

Compound fractures are much more difficult to treat with success, and far more exposed to complications of all kinds. They usually unite by suppuration and granulation, especially in the lower extremity; the inflamed bone often dies; the matter frequently burrows about the limb, requiring incisions in various parts, which interfere with the application of the splints. The surgeon, therefore, has to be constantly on the watch to provide free exit for retained matter, to remove sequestra, to incise tense, inflamed parts, and to combat all other complications. I have elsewhere expressed my strong sense of the value of the so-called 'antiseptic' method in cases of this nature (see page 20).

Wounds of bone and injuries of cartilage.

Wounds of bone are not exactly the same things as fractures, yet it is difficult to establish any essential difference. As seen in practice they are generally caused by gunshot, which sometimes perforates the bone, punching a hole more or less cleanly through it, or else splinters, and comminutes its substance, causing a compound fracture. In rarer cases the bones are cut into by a sharp-edged weapon, without any solution of continuity of the entire bone, though very probably fissures may run down, radiating from the wound to some distance in its substance. These wounds of bone are liable to many of the same dangers as compound fractures, and they unite by the same process.

Closely connected also with the subject of fractures of the bones is that of injury of cartilages. In many cases of fracture—in all those which communicate with joints, and in many of those of the ribs—the cartilages are also fractured; and many wounds involve the cartilages to a greater or less extent. Some of these injuries are definite subjects of surgical treatment—as, for instance, fracture of the costal cartilages—which will be found treated of in the sequel; but as a general rule the injury is an unnoticed and a subordinate complication of a graver lesion. The process of union will be spoken of hereafter.

UNION OF FRACTURES.

The union of simple fractures is generally effected by a process of inflammatory exudation and organisation analogous to that of union by first intention in soft parts; while compound fractures usually unite by a process of suppuration and granulation (second intention); but exceptions occur to both these rules, i.e. we meet sometimes with simple fractures which heal by suppuration, and with compound fractures which unite by simple adhesion.



FIG. 31. A badly-set fracture of the femur. The two fragments are united by a bridge of soft bone, which at the time of the patient's death (ten weeks after the accident) was so porous as to give way in part during maceration. The ends of the medullary canal are sealed. The upper fragment is lying on the inner side of the lower; the lower fragment is directed from below outwards and backwards.—From St. George's Hospital Museum, Ser. i. No. 167.

Union of uninflamed simple fracture.

The process of union of a simple fracture may be thus described:—

The injury causes effusion of blood around the fractured ends, and between the bone and periosteum, as far as the latter is torn away from the bone. The muscles also are more or less lacerated. All this is repaired in the usual way; the blood being gradually absorbed,[1] and the muscular fibres united by fibrous tissue. This process is going on simultaneously with that of the repair of the fracture itself.

Supposing the fracture to be placed in good apposition and kept quiet, a fibrinous material is exuded between the fractured ends. The period at which this exudation commences varies with many circumstances — the patient's age, the size of the bone, &c. For a large bone in an adult it may be given at about ten or twelve days. The exudation (technically termed 'callus') is furnished by the vessels both of the bone and of the periosteum.



FIG. 32. Union of fracture by the attachment to each fragment of a bridge formed by a separated splinter.—From a preparation (No. 2,938) in the Museum of the Royal College of Surgeons. ('Syst. of Surg.,' 3rd ed. vol. i. p. 435.)

[1] The reader may be referred to a paper by Mr. J. Greig Smith, on the 'Histology of Fracture-repair in Man,' 'Journ. of Anat. and Phys.' Jan. 1882, and to Mr. Jacobson's essay on Fractures, 'Syst. of Surg.' 3rd ed. vol. i. p. 436, for a very interesting account of the changes in the blood-clot around fractured bones. If these researches are confirmed they would prove that clot does in some cases (though probably not usually) ossify, and thus takes an important part in the union of fracture.

Fibrous tissue and earthy material are developed in this exudation almost simultaneously in many cases; and sometimes, especially in children, fibro-cartilage. True cartilage is met with in animals, but its occurrence in man is doubtful. The 'callus,' or uniting material, is then developed into bone, as in the intramembranous process of ossification. The new bone is spongy and porous at first, but gradually hardens.

If the fragments are not in good position this tissue may fill up the angle between them, or even extend into the medullary tube. It fills all the space internal to the periosteum (i.e. the whole medullary canal); and if the periosteum has been torn, that membrane is at first lost in a mass of newly-formed callus. Gradually this mass is modelled down, the medullary tube is restored, and the periosteum again becomes recognisable.

When the fragments overlap, the uniting medium is developed only between them—not, as a rule, over the exposed ends or in the medullary canal; but as to the latter point there is considerable variety in different cases. Fig. 81 shows a simple fracture, where the patient died before the union was quite firm. The callus which was thrown out has become ossified, though the ossification is not yet complete. The bony deposit, however, is seen to extend over the end of the medullary canal of the upper fragment; and this is the case in the lower fragment also. If the reader will compare some of the illustrations to the chapter on INJURIES OF THE LOWER EXTREMITY he will find that the condition of the medullary canal varies considerably. It is difficult to draw any precise limit between the process now described and that union by ensheathing callus which will be described presently. In this simple form of union, however, the uniting material usually fills up only the angle between the fragments and the space which is left between the detached periosteum and the bone, and this space is not often great. But there are cases where such periosteal deposits, uniting with separated splinters, form substantial bridges across the fracture, and afford a great deal of the solid uniting material (fig. 82).

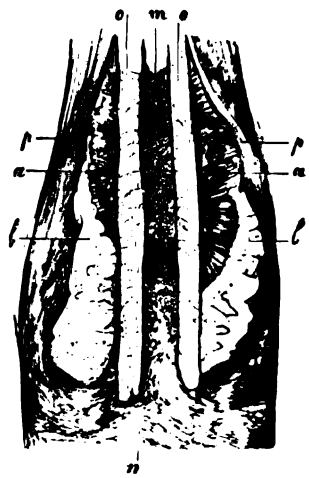


FIG. 83. The upper fragment from a fracture in an animal. The lower fragment is not shown, but exhibited similar characters. *o*, the old bone; *m*, its medulla; *a*, new bone, containing a large quantity of embryonic medulla, which renders it opaque. The general direction of the vessels in this new bone is perpendicular to the surface of the old bone; *b*, cartilage; *n*, embryonic tissue interposed between the two fragments and penetrating into the medullary cavity; *p*, circumjacent tissues blending with the periosteum. – From Cornil and Ranvier.

The microscopic appearances of the parts concerned in the fracture are those of inflammatory changes in the periosteum, endosteum, and bone. The periosteum becomes quickly much swollen and softened for some two or three inches on each fragment (the amount and extent of this varying with the severity of the injury and the amount of disturbance afterwards), and the thickened portions of periosteum blend and unite into a single mass at the seat of fracture. This mass has essentially the same structure as the inflamed deep layer of the periosteum with which it is continuous, and it is developed into bone exactly as in the ossifying (or chronic) form of periostitis, the membrane becoming swollen and studded with cells (leucocytes) which are sometimes encapsuled in hyaline material, so as exactly to resemble cartilage, and in this softened mass bony spiculæ are formed just as in normal processes of

ossification. The soft spongy bone so produced gradually hardens and becomes modelled down, so as in the best cases to leave hardly a trace in after-life; and the closer the apposition of the fragments and the more careful the treatment, the smaller is the amount of the uniting medium, and the nearer does the process approach to that of the natural growth of bone. So for the fractured ends. At first they soften and become spongy in the rarefying stage of ostitis; 'the lime salts disappear, and the cellular medullary tissue set free forms a spongy mass of callus that closes the end of the shaft, and meets with the corresponding mass in the other fragment. These masses unite with each other, so that the continuity can be at once restored by the ossification of this *internal callus*. Afterwards, when this callus has become thoroughly developed into ivory bone, a modelling process of atrophy re-absorbs that portion which filled up the marrow-canal.'[1] The same observations apply to this internal as to the external callus, viz. that its amount and the proofs of its inflammatory nature vary with the severity of the lesion and the amount of disturbance.

Union by provisional callus.

In animals, and in man when the fractured ends are not kept quiet, this process is modified by the formation round the fractured ends of a ring or splint of 'provisional' or 'ensheathing' callus.

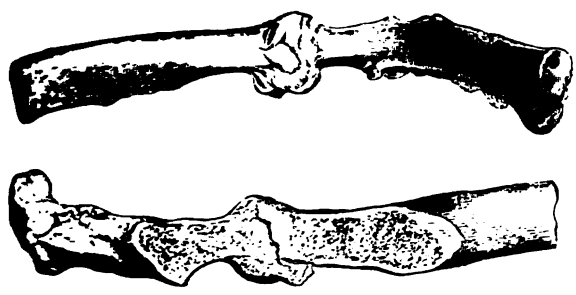


Fig. 34. Union by provisional callus in the human subject. The provisional callus has ossified, the fractured ends being still united by fibrous tissue only. A fractured rib three months after the accident. — St. George's Hospital Museum, Ser. i. No. 72. ('Syst. of Surg.,' 3rd ed. vol. i. p. 432.)

The process of formation of provisional callus has been artificially divided into five stages:—

1. The first is that of exudation of reparative material, external and internal to the fragments, i.e. between the fragments and the periosteum, and between the medullary membrane and the bone. This occupies a period averaging from eight to ten days.

2. The provisional callus then acquires the firmness and structure of fibro-cartilage or cartilage in from ten to twenty-five days.

3. Both the external and internal callus then ossify into spongy bone in from twenty-five to sixty days.

4. The provisional bony callus is then modelled down and becomes compact bone, the ends of the fracture being still distinct from each other (fig. 34).

5. Lastly, the permanent bond of bony union, or 'permanent callus,' forms between the broken ends, and the provisional callus is more or less completely re-absorbed; so that the periosteal swelling disappears, and the medullary canal is restored. The period occupied by these two latter stages of the process is too uncertain to be stated even approximately.

In some cases the provisional bony callus remains permanent, and the fractured ends lie within it, either ununited or only connected by ligament.

As the formation of provisional callus is the result of the irritation produced by motion of the fragments, it is exceptional in man, though by no means unknown; while, on the other hand, its absence is rare, though also not unknown, in animals. In the human subject the ribs, which cannot be

[1] Wilks and Moxon, 'Path. Anat.' pp. 33, 34.

kept immovable, usually unite in this manner, and the clavicle for the same reason very generally. Any fracture, however, which from accidental circumstances cannot be treated in the usual manner may undergo this process, of which the humerus represented in the annexed figure (fig. 35) is a good example. For obvious reasons it is more common in childhood. The buttresses of bone which are sometimes found around fractures, particularly near the hip, are analogous to the provisional callus, and are formed by a process of ossification going on in the fibrous tissue and tendons around the fracture, which has been denominated *parostosis*, and which the reader will find minutely described and figured by Mr. Jacobson in the 'System of Surgery,' 3rd ed. vol. i. p. 437.



FIG. 35. Union of fracture by ensheathing or provisional callus in the human subject. The patient was admitted into hospital with fracture of the humerus, which could never be kept quiet, in consequence of his suffering from repeated attacks of delirium tremens, of which he died about a month after the accident.
A dentated fracture was found just below the insertion of the deltoid muscle, and the fractured ends were encased in a sheath or ferule of fibrous tissue about a quarter of an inch thick, and extending about an inch above and below the fracture. A hole has been cut in this sheath in order to show the extremities *a a* of the fractured bone; *b* points to the hole, or window, which has been cut in the provisional callus. The fragments *a*, *a*, are entirely ununited to each other, and are free from any periosteal deposit of callus. They are freely movable on each other to the extent permitted by the attachment of the provisional callus.—St. George's Hospital Museum, Ser. i. No. 105.

The union of inflamed simple fractures and of compound fractures is by granulation. The fractured ends are enclosed in an imperfect capsule formed by the thickened and inflamed soft parts, within which the injured ends of the bone suppurate, and often become necrosed in part; granulations spring up from them; the medullary canal is more or less trenched upon, and perhaps filled up with ossifying material, in which bone is slowly and irregularly deposited. The medullary canal is often permanently closed, especially when it has been freely exposed (as by the projection of the fragment); but occasionally after a long period it may be restored. This union by granulation is a far more tedious process than that by adhesion, generally occupying as many months as the other does weeks; and it is liable to all kinds of irregularities, from the separation of fragments which become necrosed in consequence of the suppuration of the parts which surround and nourish them, from erysipelas or diffuse inflammation, from burrowing of matter in the limb in fact, from all the complications incidental to severe injuries involving bone. And such suppurating compound fractures are one of the most fruitful sources of pyæmia. It is therefore important to procure the immediate union of the wound—whenever that is possible so as to convert the compound into a simple fracture; and this is the more important the more vital is the organ which is in contact with the fractured bone. Hence the care with which surgeons endeavour to procure the union of a scalp-wound which exposes a fracture of the skull, or a wound of the chest communicating with a fractured rib. But it must be added that such attempts are of very doubtful utility in cases where, from extensive laceration and contusion, the wound must almost inevitably suppurate, and where the consequent suppuration will be prevented from finding an exit by the material used in sealing the wound. Much, however, may doubtless be done by carefully

sealing wounds with some antiseptic substance, and keeping all their parts in gentle apposition by appropriate bandaging; but in so treating the wound of a compound fracture the surgeon should watch vigilantly for any indication of burrowing matter, and give it instant vent.

Irregularities occur in all these processes, whereby special cases are made to differ from that which is regarded as the typical course of each kind of union. The chief of these irregularities which needs notice here is the absorption which sometimes goes on in the neighbouring bone contemporaneously with the union of the line of fracture itself. This is often seen in thin papery bones like those of the orbit (see INJURIES OF THE HEAD). And it is often noticed that fractures of the base of the skull, though they may unite, do so very imperfectly, and that parts of the fissure are often wider when the repair is complete than they were at the time of the injury. Irregular union.

The arrest of the process of union at any stage will lead to the various forms of ununited fracture, as will be obvious from the sequel.

The usual period for the union of each fracture is specified in treating of each. But it must be understood that these periods are averages only. Various disturbances of health may cause delay in union—such as acute diseases, as fever, or chronic affections, as scurvy, possibly syphilis, and frequently disease of the kidneys leading to a phosphatic state of the urine.[1] All such causes, however, allowing the reality of all of them (which is a matter of considerable doubt), are rare; far more commonly the union of fracture is delayed or prevented by injudicious treatment, as by tight bandaging, obstructing the blood-supply, or the other extreme of negligent apposition, allowing movement. But cases of delayed union are met with in which no such cause can be traced, where the patient seems to be in his usual health, and the fracture to have been properly treated.[2] Delayed union.



Fig. 36. Ununited fracture (soft union) of the ulna.—St. George's Hospital Museum, Ser. I. No. 202a.

In such instances of delayed union the indications for treatment are obviously, in the first place, to examine the patient's local and general condition, with a view to correct alkalescence of urine by the exhibition of mineral acids, to neutralise the syphilitic condition by mercury or iodide of potassium, and to improve the general health by fresh air if possible. The local condition must be improved by correcting any obvious defect in the apparatus employed, and by gently rubbing or shampooing the parts around the fracture. Some fractures of the lower limb, which have remained movable beyond the usual time, will unite if the patient is allowed to get up and move about a little with the limb in a splint firm enough to prevent it from bend-

[1] Pregnancy and lactation are said sometimes to retard union, though they certainly do not commonly do so. The subject is discussed, and several interesting cases quoted, in Norris, 'Contributions to Practical Surgery,' pp. 25, 28. The cutting off of the blood-supply through the nutrient artery is also believed by Mr. Curling to retard union ('Med.-Chir. Trans.,' vol. xx.). And Mr. Callender has pointed out the frequency of obstruction of the main vein from contusion in the injury, causing œdema, as a condition involving delay in the union of the fracture ('Med.-Chir. Trans.,' vol. li. p. 152).

[2] On the far greater frequency of the local causes of non-union, especially bad treatment, than the constitutional, see Callender, op. cit. Simple fractures appear to remain ununited far more commonly than similar compound fractures do.

ing, yet not so tight as to make it swell. In other cases (whether in the upper or lower limb) union may be procured by fixing the two fragments in an apparatus made of two parts movable on each other, and provided with a screw and ratchet, by which the fragments can be pressed together. The aim of all these devices is to excite a little more action in the parts, and thus stimulate the fractured ends to throw out bone.

Ununited fracture.

By some such means as these union may be procured, even after considerable delay, when there is no definite obstacle to it. There will still remain a small proportion of cases in which the fragments continue permanently ununited—at least by bone—and therefore are freely movable on each other.

This takes place in one of three ways, i.e. the fragments are either united by a soft material (which is sometimes called ligamentous union) or by a false joint; or they are truly ununited, i.e. are in no apposition whatever.

Ligamentous union.

The first form of ununited fracture is seen in fig. 36, and a comparison of fig. 35 will show its striking similarity to the condition of a provisional callus before ossification. Sometimes, indeed, in these cases of soft union there is a regular provisional callus enclosing the broken ends in a splint or ferule, just as is seen in animals, and possibly containing fibro-cartilage. This soft or ligamentous union is the most common condition of ununited fracture.

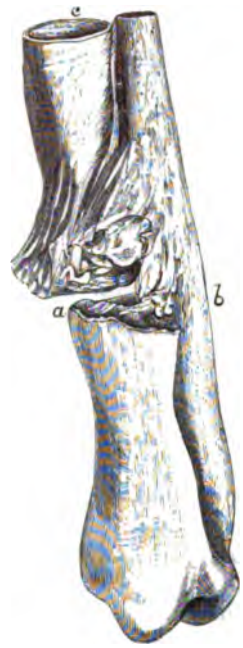


FIG. 37. An ununited fracture (false joint) of the tibia. The fracture had existed seventeen years, and the utility of the limb had been almost perfect, the patient having gained his livelihood by walking as a messenger at one of the clubs; he merely used a stick. The ends of the fracture, *a*, are rounded, the lower end being worn into a kind of cup to receive the upper end. They are lined by a fibro-cartilaginous substance, and were enclosed in a firm fibrous capsule, which has been removed in order to display the false joint. There was even a membrane lining the ends and secreting a substance something like synovia. A false joint also exists between the tibia and fibula, near the fracture. The fibula, *b*, is much curved and is very much thickened, so as to bear the weight of the body. The tibia, as shown at *c*, is considerably atrophied, so that a thin shell only remains to represent its compact exterior.—From a specimen in St. George's Hospital Museum, Ser. i. No. 202.

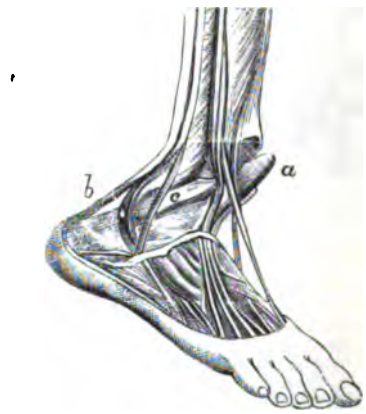


FIG. 38. Ununited fracture of both bones of the leg in a child æt. 10, for which amputation was performed. The leg had been fractured eight years before, and had, it was said, been re-fractured on two subsequent occasions. *a*. The atrophied upper end of the lower fragment of the tibia, above which is seen the lower end of the upper fragment. This is not in any contact with the former, but is united to the back of the lower fragment below by a kind of capsular membrane. This is the case also with the fibula. The upper end of the lower fragment of the fibula is not plainly seen, being buried in the fibres of the extensor long. dig. *c*. shows the lower fragment of the fibula. The tendons of the tib. anticus and extr. prop. pollicis are seen, pushed outwards by the fragment of the tibia. *b*. shows the heel and the atrophied Tendo Achillis.—From St. George's Hospital Museum, Ser. i. No. 203.

False joint.

Another form of the lesion is that which is shown in fig. 37, in which by the movement of the two parts of the fracture on each other a *false joint*

'pseudarthrosis') has been formed in the centre of the soft uniting medium, which then takes the form of a more or less regular capsule.[1]

Again, the broken ends may be in no apposition at all. A familiar example is that of a fracture of the patella, where the fragment is sometimes drawn far up the thigh, and is quite unconnected with the part which remains attached to the tibia. Fig. 38 shows another example of something of this kind. In that preparation, however, though the upper ends of the lower fragments are in no connection whatever with the lower ends of the upper fragments, yet these latter have an imperfect fibrous connection to a lower part of each lower fragment, so that it may be said that some attempt, though very imperfect and ineffectual, has been made to re-establish the solidity of the limb. True non-union.

It is not easy during life to give a confident opinion as to the exact anatomical condition of a case of ununited fracture; but if the fractured ends are widely separated, and no motion of one is produced by moving the other, we may suspect entire non-union; if they move freely on each other with grating, or pseudo-crepitus, like that felt in an old rheumatic joint, we conclude that the case is probably one of false joint; if they are more or less freely movable on each other, but without grating, we may put it down as probably an instance of ligamentous union, remembering also that this is by far the most common condition, as it is also the most favourable for treatment.

In cases of true non-union, and frequently in those of false joint, the fragments are greatly atrophied, as shown in the figures; in some rarer cases of false joint they may be enlarged.

The treatment of ununited fracture must be regulated in the first place by the utility of the limb, and in the next place by the age and health of the patient. The former varies very greatly. Thus fig. 37 shows a case in which the fibula having remained unbroken (or having united), and having also become sufficiently hypertrophied to bear the weight of the body, the leg was so useful that the patient could earn his living by walking. In such a case it is needless to say that there is no motive for surgical interference. Mr. Prescott Hewett told me of a case which he had seen in private, where a lady had an ununited fracture of the femur. This was most freely movable when she lay down, but when she stood up the two fragments locked together in such a way that she could walk fairly well, though with a limp. In such a case, and in fact generally, when the patient's life is not made wretched by his infirmity, it is better to avoid any serious operation, for all such operations involve a good deal of danger. All operations on the upper limb are both more likely to succeed and much less dangerous than similar operations on the lower extremity. As there is no absolute separation between cases of delayed union and those of non-union, it is better to treat every case when first seen, if at any reasonable period after the injury, by the milder measures which have been recommended in cases of delayed union. I have seen judicious apposition and mutual pressure of the fragments on each other by means of a rack-and-pinion apparatus successfully employed in such cases. Shampooing the part, slight rubbing of the fragments on each other, occasional slight inflammation set up by blisters and other means, have been recommended. Mr. Thomas speaks of having cured ununited fractures by striking the parts with a mallet.[2] And of course careful attention to the general health, and Treatment.

[1] There is an interesting preparation in the Museum of the College of Surgeons showing numerous loose bodies ('loose cartilages') in one of these false joints. See 'Syst. of Surg.' Lond. vol. i. p. 441.

[2] Liverpool and Manchester Reports, 1876, p. 27.

especially the condition of the urine, is understood to be a necessary preliminary to all kinds of treatment.

If these means fail, and if the loss of power is not grave enough in the surgeon's judgment to justify his exposing the patient to any risk of his life, or if the patient is in such a condition of health that he can hardly be expected to survive the operation, the case must be abandoned, with such palliation as an apparatus can provide.

In cases, however, which are more hopeful as far as the patient is concerned, and where the infirmity is grave enough to justify the risk, the surgeon must very carefully examine the relations of the fragments to each other; their connection, as far as he can make it out, their size, and the possibility of bringing their ends into apposition by extension. He then has the choice of a great number of expedients. There are cases of false joint in which the cavity between the fragments may be obliterated by scraping the ends with a tenotomy-knife, keeping them afterwards at rest in the natural position; and other cases where union seems to be prevented by some piece of muscle or fascia which has got between the fragments, and where a similar operation will succeed. There are cases (apparently both of false joint and of ligamentous union) where ossification has ensued on the passage of a seton between the ends, which should not be allowed to remain in much above a week. The measure appears to have had little success in England. Dr. Norris, however, says of it that 'results in America have proved it one of the safest, least painful, and most efficacious of the numerous operations that are performed for the cure of pseudarthrosis' (op. cit. p. 90). Sometimes the surgeon has cut down on the fractured ends in order to pass the seton; but, as a general rule, when a seton cannot be passed without a previous exposure of the bone, the probably more effectual and certainly less dangerous expedient is adopted of driving ivory pegs into the fragments, as recommended by Dieffenbach. The fragments are sufficiently exposed to drill holes into them, and then into these holes ivory pegs are driven, and the projecting ends cut off. The buried part excites an effusion of bone around, and by such effusion the fracture is united, much as it is by the periosteal bridge of bone figured on p. 119. The buried part of the peg sometimes makes its way out, sometimes perhaps is absorbed, and probably is sometimes encapsuled, and remains as lodged bullets do. The number of pegs to be driven into each fragment will depend on the size of the bone, and other circumstances. Mr. Erichsen speaks of having successfully used five pegs in a fracture of the humerus. Mr. Bickersteth has used copper nails in the same way,[1] or has driven a drill, the end of which is removable, from one fragment into but not through the other, and left the drill in the bone until it fell out. If one drill be not enough to support the fragments, two or even more can be employed, a plan which has the advantage of requiring no external incision. The drills are simply driven in from the surface of the body.

Another plan is to drive a metal suture from one end into the other by means of the drill, which is made to perforate both fragments obliquely;[2] but this is commonly combined with the next plan, viz.:

To cut down on the fracture and to remove a slice from either fragment, after which the ends may be wired together, if the surgeon thinks right. Mr. Mason suggests that a needle may be driven through the ends, and the wire cast

[1] 'Med.-Chir. Trans.' vol. xlvii. p. 115. See also Mr. Hill's paper in Liverpool and Manchester Reports, 1876, p. 64.

[2] Mason, 'Med.-Chir. Trans.' vol. liv. p. 313. Thomas on 'Fractures of the Lower Jaw.'

in a loop or figure of 8 round the needle, and this may be necessary when the surfaces are very oblique, otherwise the simple insertion of a peg or pin is sufficient to keep the fragments in apposition.

Sub-periosteal resection.

The late Mr. Jordan of Manchester suggested the sub-periosteal resection of the fragments,[1] a tube of periosteum being dissected up first, and the portions of bone removed, as far as possible bare of periosteum; and though this may not always be practicable, yet there is no doubt of the desirability of saving any periosteum which can be recognised and separated from the bone.

Transplantation of bone.

Lately an operation has been described by Professor Nussbaum of Munich in a case of non-union of the ulna, the result of loss of bone from gunshot fracture, which he denominates 'transplantation of bone.'[2] It consists essentially in cutting off from the rest of the bone a portion of its external shell covered by the periosteum, and leaving this shell of bone attached to the remainder by means of the periosteum covering its terminal extremity, which is to be carefully preserved from injury, since it is the medium of the future repair. The semi-detached and now quite movable bone is next displaced into the gap in the same way as a flap of skin is twisted in a plastic operation and fixed in the indurated soft tissues of which the gap is formed. The uniting ligament and the atrophied ends of the fracture, together with the cartilaginous [fibrous ?] tissue which covered them are removed, as being in the way. This operation could only be attempted in cases where the separation between the fragments is unusually great: and its utility must be tested by further experience.

After all operations for ununited fracture it will be recollected that careful support in a firm splint or case of leather, plaster of Paris, or other material is indispensable.

There are many cases where subcutaneous section of the muscles which displace the fragments must be added to the other operative proceedings.

Amputation.

Finally, there are cases so complicated, or of such long standing, or where previous operations have so far failed, that amputation may be best.

Vicious union.

The fracture may have united by bone, but with considerable deformity and loss of the functions of the limb. The various kinds of *vicious union* spoken of are union of two contiguous bones, union with displacement, and projection of one of the fragments. The first and last may be summarily dismissed. Union of two contiguous bones is of no importance in the ribs, and of comparatively little in the leg. In the forearm it has, in one recorded case, been held to justify the resection of the bone.[3] Projection of one of the fragments, or possibly of a comminuted piece, is to be dealt with like any other exostosis, i.e. when sufficiently inconvenient the projecting piece must be removed. But the cases we are ordinarily called upon to treat are those in which, from neglect, from unruliness on the part of the patient, or from yielding of the union after supposed cure, the deformity has either never been corrected or has recurred, and the limb is more or less entirely useless. Such cases are by no means hopeless. If only a short time has elapsed after the injury the deformity will often yield to extension by the pulleys, combined with firm pressure on the part, under chloroform; or it may be reduced more gradually (as bent bones are in childhood) by pressure, with pads, &c., on the angle; the pressure being antagonised by a splint on the opposite side of the limb. In many cases re-

Re-fracture of bone.

[1] 'Traitement des Pseudarthroses par l'Autoplastie périostique,' Paris, 1860.

[2] 'Lond. Med. Record,' March 31, 1875.

[3] By Gardeil, quoted by Malgaigne, p. 272, Packard's translation.

kept immovable, usually unite in this manner, and the clavicle for the same reason very generally. Any fracture, however, which from accidental circumstances cannot be treated in the usual manner may undergo this process, of which the humerus represented in the annexed figure (fig. 35) is a good example. For obvious reasons it is more common in childhood. The buttresses of bone which are sometimes found around fractures, particularly near the hip, are analogous to the provisional callus, and are formed by a process of ossification going on in the fibrous tissue and tendons around the fracture, which has been denominated *parostosis*, and which the reader will find minutely described and figured by Mr. Jacobson in the 'System of Surgery,' 3rd ed. vol. i. p. 437.

Union by granulation.

The union of inflamed simple fractures and of compound fractures is by granulation. The fractured ends are enclosed in an imperfect capsule formed by the thickened and inflamed soft parts, within which the injured ends of the bone suppurate, and often become necrosed in part; granulations spring up from them; the medullary canal is more or less trenched upon, and perhaps filled up with ossifying material, in which bone is slowly and irregularly deposited. The medullary canal is often permanently closed, especially when it has been freely exposed (as by the projection of the fragment); but occasionally after a long period it may be restored. This union by granulation is a far more tedious process than that by adhesion, generally occupying as many months as the other does weeks; and it is liable to all kinds of irregularities, from the separation of fragments which become necrosed in consequence of the suppuration of the parts which surround and nourish them, from erysipelas or diffuse inflammation, from burrowing of matter in the limb—in fact, from all the complications incidental to severe injuries involving bone. And such suppurating compound fractures are one of the most fruitful sources of pyæmia. It is therefore important to procure the immediate union of the wound—whenever that is possible—so as to convert the compound into a simple fracture; and this is the more important the more vital is the organ which is in contact with the fractured bone. Hence the care with which surgeons endeavour to procure the union of a scalp-wound which exposes a fracture of the skull, or a wound of the chest communicating with a fractured rib. But it must be added that such attempts are of very doubtful utility in cases where, from extensive laceration and contusion, the wound must almost inevitably suppurate, and where the consequent suppuration will be prevented from finding an exit by the material used in sealing the wound. Much, however, may doubtless be done by carefully



FIG. 35. Union of fracture by ensheathing or provisional callus in the human subject. The patient was admitted into hospital with fracture of the humerus, which could never be kept quiet, in consequence of his suffering from repeated attacks of delirium tremens, of which he died about a month after the accident.

A dentated fracture was found just below the insertion of the deltoid muscle, and the fractured ends were encased in a sheath or ferule of fibrous tissue about a quarter of an inch thick, and extending about an inch above and below the fracture. A hole has been cut in this sheath, in order to show the extremities *a a* of the fractured bone; *b* points to the hole, or window, which has been cut in the provisional callus. The fragments *a*, *a*, are entirely ununited to each other, and are free from any periosteal deposit of callus. They are freely movable on each other to the extent permitted by the attachment of the provisional callus. St. George's Hospital Museum, Ser. i. No. 105.

sealing wounds with some antiseptic substance, and keeping all their parts in gentle apposition by appropriate bandaging; but in so treating the wound of a compound fracture the surgeon should watch vigilantly for any indication of burrowing matter, and give it instant vent.

Irregularities occur in all these processes, whereby special cases are made to differ from that which is regarded as the typical course of each kind of union. The chief of these irregularities which needs notice here is the absorption which sometimes goes on in the neighbouring bone contemporaneously with the union of the line of fracture itself. This is often seen in thin papery bones like those of the orbit (see INJURIES OF THE HEAD). And it is often noticed that fractures of the base of the skull, though they may unite, do so very imperfectly, and that parts of the fissure are often wider when the repair is complete than they were at the time of the injury. Irregular union.

The arrest of the process of union at any stage will lead to the various forms of ununited fracture, as will be obvious from the sequel.

The usual period for the union of each fracture is specified in treating of each. But it must be understood that these periods are averages only. Various disturbances of health may cause delay in union—such as acute diseases, as fever, or chronic affections, as scurvy, possibly syphilis, and frequently disease of the kidneys leading to a phosphatic state of the urine.[1] All such causes, however, allowing the reality of all of them (which is a matter of considerable doubt), are rare; far more commonly the union of fracture is delayed or prevented by injudicious treatment, as by tight bandaging, obstructing the blood-supply, or the other extreme of negligent apposition, allowing movement. But cases of delayed union are met with in which no such cause can be traced, where the patient seems to be in his usual health, and the fracture to have been properly treated.[2] Delayed union.



M. Ununited fracture (soft union) of ulna.—St. George's Hospital Museum, Ser. . No. 2072a.

In such instances of delayed union the indications for treatment are obviously, in the first place, to examine the patient's local and general condition, with a view to correct alkalescence of urine by the exhibition of mineral acids, to neutralise the syphilitic condition by mercury or iodide of potassium, and to improve the general health by fresh air if possible. The local condition must be improved by correcting any obvious defect in the apparatus employed, and by gently rubbing or shampooing the parts around the fracture. Some fractures of the lower limb, which have remained movable beyond the usual time, will unite if the patient is allowed to get up and move about a little with the limb in a splint firm enough to prevent it from bend-

[1] Pregnancy and lactation are said sometimes to retard union, though they certainly do commonly do so. The subject is discussed, and several interesting cases quoted, in Erne, 'Contributions to Practical Surgery,' pp. 25, 28. The cutting off of the blood-supply through the nutrient artery is also believed by Mr. Curling to retard union ('Med.-Chir. Trans.,' vol. xx.). And Mr. Callender has pointed out the frequency of obstruction of the main vein from contusion in the injury, causing œdema, as a condition involving delay in the union of the fracture ('Med.-Chir. Trans.,' vol. li. p. 152).

[2] On the far greater frequency of the local causes of non-union, especially bad treatment, than the constitutional, see Callender, op. cit. Simple fractures appear to remain ununited far more commonly than similar compound fractures do.

ing, yet not so tight as to make it swell. In other cases (whether in the upper or lower limb) union may be procured by fixing the two fragments in an apparatus made of two parts movable on each other, and provided with a screw and ratchet, by which the fragments can be pressed together. The aim of all these devices is to excite a little more action in the parts, and thus stimulate the fractured ends to throw out bone.

Ununited fracture.

By some such means as these union may be procured, even after considerable delay, when there is no definite obstacle to it. There will still remain a small proportion of cases in which the fragments continue permanently ununited—at least by bone—and therefore are freely movable on each other.

This takes place in one of three ways, i.e. the fragments are either united by a soft material (which is sometimes called ligamentous union) or by a false joint; or they are truly ununited, i.e. are in no apposition whatever.

Ligamentous union.

The first form of ununited fracture is seen in fig. 36, and a comparison of fig. 35 will show its striking similarity to the condition of a provisional callus before ossification. Sometimes, indeed, in these cases of soft union there is a regular provisional callus enclosing the broken ends in a splint or ferule, just as is seen in animals, and possibly containing fibro-cartilage. This soft or ligamentous union is the most common condition of ununited fracture.



FIG. 37. An ununited fracture (false joint) of the tibia. The fracture had existed seventeen years, and the utility of the limb had been almost perfect, the patient having gained his livelihood by walking as a messenger at one of the clubs; he merely used a stick. The ends of the fracture, *a*, are rounded, the lower end being worn into a kind of cup to receive the upper end. They are lined by a fibro-cartilaginous substance, and were enclosed in a firm fibrous capsule, which has been removed in order to display the false joint. There was even a membrane lining the ends and secreting a substance something like synovia. A false joint also exists between the tibia and fibula, near the fracture. The fibula, *b*, is much curved and is very much thickened, so as to bear the weight of the body. The tibia, as shown at *c*, is considerably atrophied, so that a thin shell only remains to represent its compact exterior.—From a specimen in St. George's Hospital Museum, Ser. i. No. 202.



FIG. 38. Ununited fracture of both bones of the leg in a child æt. 10, for which amputation was performed. The leg had been fractured eight years before, and had, it was said, been re-fractured on two subsequent occasions. *a*. The atrophied upper end of the lower fragment of the tibia, above which is seen the lower end of the upper fragment. This is not in any contact with the former, but is united to the back of the lower fragment below by a kind of capsular membrane. This is the case also with the fibula. The upper end of the lower fragment of the fibula is not plainly seen, being buried in the fibres of the extensor long. dig. *c*, shows the lower fragment of the fibula. The tendons of the tib. anticus and extr. prop. pollicis are seen, pushed outwards by the fragment of the tibia. *b*. shows the heel and the atrophied Tendo Achillis. From St. George's Hospital Museum, ser. i. No. 203.

False joint.

Another form of the lesion is that which is shown in fig. 37, in which by the movement of the two parts of the fracture on each other a *false joint*

('pseudarthrosis') has been formed in the centre of the soft uniting medium, which then takes the form of a more or less regular capsule.[1]

Again, the broken ends may be in no apposition at all. A familiar example is that of a fracture of the patella, where the fragment is sometimes drawn far up the thigh, and is quite unconnected with the part which remains attached to the tibia. Fig. 38 shows another example of something of this kind. In that preparation, however, though the upper ends of the lower fragments are in no connection whatever with the lower ends of the upper fragments, yet these latter have an imperfect fibrous connection to a lower part of each lower fragment, so that it may be said that some attempt, though very imperfect and ineffectual, has been made to re-establish the solidity of the limb. True non-union.

It is not easy during life to give a confident opinion as to the exact anatomical condition of a case of ununited fracture; but if the fractured ends are widely separated, and no motion of one is produced by moving the other, we may suspect entire non-union; if they move freely on each other with grating, or pseudo-crepitus, like that felt in an old rheumatic joint, we conclude that the case is probably one of false joint; if they are more or less freely movable on each other, but without grating, we may put it down as probably an instance of ligamentous union, remembering also that this is by far the most common condition, as it is also the most favourable for treatment.

In cases of true non-union, and frequently in those of false joint, the fragments are greatly atrophied, as shown in the figures; in some rarer cases of false joint they may be enlarged.

The treatment of ununited fracture must be regulated in the first place by the utility of the limb, and in the next place by the age and health of the patient. The former varies very greatly. Thus fig. 87 shows a case in which the fibula having remained unbroken (or having united), and having also become sufficiently hypertrophied to bear the weight of the body, the leg was so useful that the patient could earn his living by walking. In such a case it is needless to say that there is no motive for surgical interference. Mr. Prescott Hewett told me of a case which he had seen in private, where a lady had an ununited fracture of the femur. This was most freely movable when she lay down, but when she stood up the two fragments locked together in such a way that she could walk fairly well, though with a limp. In such a case, and in fact generally, when the patient's life is not made wretched by his infirmity, it is better to avoid any serious operation, for all such operations involve a good deal of danger. All operations on the upper limb are both more likely to succeed and much less dangerous than similar operations on the lower extremity. As there is no absolute separation between cases of delayed union and those of non-union, it is better to treat every case when first seen, if at a reasonable period after the injury, by the milder measures which have been recommended in cases of delayed union. I have seen judicious apposition and mutual pressure of the fragments on each other by means of a rack-and-pinion apparatus successfully employed in such cases. Shampooing the part, slight rubbing of the fragments on each other, occasional slight inflammation set up by blisters and other means, have been recommended. Mr. Thomas speaks of having cured ununited fractures by striking the parts with a mallet.[2] And of course careful attention to the general health, and Treatment.

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If these means fail, and if the loss of power is not grave enough in the surgeon's judgment to justify his exposing the patient to any risk of his life, or if the patient is in such a condition of health that he can hardly be expected to survive the operation, the case must be abandoned, with such palliation as an apparatus can provide.

In cases, however, which are more hopeful as far as the patient is concerned, and where the infirmity is grave enough to justify the risk, the surgeon must very carefully examine the relations of the fragments to each other; their connection, as far as he can make it out, their size, and the possibility of bringing their ends into apposition by extension. He then has the choice of a great number of expedients. There are cases of false joint in which the cavity between the fragments may be obliterated by scraping the ends with a tenotomy-knife, keeping them afterwards at rest in the natural position; and other cases where union seems to be prevented by some piece of muscle or fascia which has got between the fragments, and where a similar operation will succeed. There are cases (apparently both of false joint and of ligamentous union) where ossification has ensued on the passage of a seton between the ends, which should not be allowed to remain in much above a week. The measure appears to have had little success in England. Dr. Norris, however, says of it that 'results in America have proved it one of the safest, least painful, and most efficacious of the numerous operations that are performed for the cure of pseudarthrosis' (op. cit. p. 90). Sometimes the surgeon has cut down on the fractured ends in order to pass the seton; but, as a general rule, when a seton cannot be passed without a previous exposure of the bone, the probably more effectual and certainly less dangerous expedient is adopted of driving ivory pegs into the fragments, as recommended by Dieffenbach. The fragments are sufficiently exposed to drill holes into them, and then into these holes ivory pegs are driven, and the projecting ends cut off. The buried part excites an effusion of bone around, and by such effusion the fracture is united, much as it is by the periosteal bridge of bone figured on p. 119. The buried part of the peg sometimes makes its way out, sometimes perhaps is absorbed, and probably is sometimes encapsuled, and remains as lodged bullets do. The number of pegs to be driven into each fragment will depend on the size of the bone, and other circumstances. Mr. Erichsen speaks of having successfully used five pegs in a fracture of the humerus. Mr. Bickersteth has used copper nails in the same way,[1] or has driven a drill, the end of which is removable, from one fragment into but not through the other, and left the drill in the bone until it fell out. If one drill be not enough to support the fragments, two or even more can be employed, a plan which has the advantage of requiring no external incision. The drills are simply driven in from the surface of the body.

Another plan is to drive a metal suture from one end into the other by means of the drill, which is made to perforate both fragments obliquely;[2] but this is commonly combined with the next plan, viz.:

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Subcutaneous scraping of the ends.

Seton.

Ivory pegs.

Drilling.

Metal sutures.

Resection of ends.

[1] 'Med.-Chir. Trans.' vol. xlvii. p. 115. See also Mr. Hill's paper in Liverpool and Manchester Reports, 1876, p. 64.

[2] Mason, 'Med.-Chir. Trans.' vol. liv. p. 313. Thomas on 'Fractures of the Lower Jaw.'

in a loop or figure of 8 round the needle, and this may be necessary when the surfaces are very oblique, otherwise the simple insertion of a peg or pin is sufficient to keep the fragments in apposition.

Sub-periosteal resection.

The late Mr. Jordan of Manchester suggested the sub-periosteal resection of the fragments,[1] a tube of periosteum being dissected up first, and the portions of bone removed, as far as possible bare of periosteum; and though this may not always be practicable, yet there is no doubt of the desirability of saving any periosteum which can be recognised and separated from the bone.

Transplantation of bone.

Lately an operation has been described by Professor Nussbaum of Munich in a case of non-union of the ulna, the result of loss of bone from gunshot fracture, which he denominates 'transplantation of bone.'[2] It consists essentially in cutting off from the rest of the bone a portion of its external shell covered by the periosteum, and leaving this shell of bone attached to the remainder by means of the periosteum covering its terminal extremity, which is to be carefully preserved from injury, since it is the medium of the future repair. The semi-detached and now quite movable bone is next displaced into the gap in the same way as a flap of skin is twisted in a plastic operation and fixed in the indurated soft tissues of which the gap is formed. The uniting ligament and the atrophied ends of the fracture, together with the cartilaginous [fibrous ?] tissue which covered them are removed, as being in the way. This operation could only be attempted in cases where the separation between the fragments is unusually great: and its utility must be tested by further experience.

After all operations for ununited fracture it will be recollected that careful support in a firm splint or case of leather, plaster of Paris, or other material is indispensable.

There are many cases where subcutaneous section of the muscles which displace the fragments must be added to the other operative proceedings.

Amputation.

Finally, there are cases so complicated, or of such long standing, or where previous operations have so far failed, that amputation may be best.

Vicious union.

The fracture may have united by bone, but with considerable deformity and loss of the functions of the limb. The various kinds of *vicious union* spoken of are union of two contiguous bones, union with displacement, and projection of one of the fragments. The first and last may be summarily dismissed. Union of two contiguous bones is of no importance in the ribs, and of comparatively little in the leg. In the forearm it has, in one recorded case, been held to justify the resection of the bone.[3] Projection of one of the fragments, or possibly of a comminuted piece, is to be dealt with like any other exostosis, and when sufficiently inconvenient the projecting piece must be removed. But the cases we are ordinarily called upon to treat are those in which, from neglect, or unruliness on the part of the patient, or from yielding of the union after supposed cure, the deformity has either never been corrected or has recurred, and the limb is more or less entirely useless. Such cases are by no means hopeless. If only a short time has elapsed after the injury the deformity will often yield to extension by the pulleys, combined with firm pressure on the part, under chloroform; or it may be reduced more gradually (as bent bones are in childhood) by pressure, with pads, &c., on the angle; the pressure being counteracted by a splint on the opposite side of the limb. In many cases re-

Re-fracture of bone.

[1] 'Traitement des Pseudarthroses par l'Autoplastie périostique,' Paris, 1860.

[2] 'Lond. Med. Record,' March 31, 1875.

[3] By Gardeil, quoted by Malgaigne, p. 272, Packard's translation.

fracture of the limb is justifiable, and in almost all in which it is indicated the attempt may be made with impunity. The danger of producing fresh fracture at the wrong place is so slight that it need hardly be taken into account. Mr. Skey[1] has shown that even the smaller bones, such as the radius or the fibula, are not easily broken, even when out of the body, by the utmost force which a strong man can exert; and, when covered by soft parts, they would be still less easy to break; while the larger bones, on which the attempt is usually made, the femur or tibia, are of course quite secure. But at the seat of fracture, and especially in cases of vicious union, the uniting material remains long imperfectly ossified, and will give way in some cases more than a year after the injury. I have seen the femur re-fractured, thirteen months after the accident, with perfect ease. The operation is a very simple one. The limb is brought over the edge of the table a little beyond the fracture; its upper part is steadied by assistants, and the surgeon leans on it with all the force he can exert till it gives way, changes of position, rotation, &c., being employed as may be necessary. Mr. Skey says, 'the act of disuniting the bone is effected by slow laceration rather than by a snap or fracture;' in fact, its possibility depends on the ossification of the callus being incomplete. After it has been effected the limb must be extended as nearly as possible to the original length, by pulleys if necessary, and fixed by splints in that position.

There may be cases in which the surgeon may think it right to divide a fracture perfectly united, but in a vicious position, at any time after the injury, and when the bone can no longer be re-fractured. This may be done either by direct incision[2] or by subcutaneous section, as is done in vicious ankylosis of joints (see below, the section on ankylosis); or, as has been ingeniously suggested by Langenbeck,[3] the projecting portion of the bone may first be considerably weakened, by boring a large hole through it, and extending this hole by means of a keyhole-saw till only a bridge remains on either side. Then the wound is dressed, and the limb put into a plaster of Paris splint, until it has healed, when the weakened part is easily fractured and put straight, and there remains only a simple fracture to treat.

Painful union.

The united bones may be in proper position, or nearly so, and yet the limb may be almost useless from inflammation of the bones or neighbouring parts, or from matting together of the tendons or other structures. These complications must be treated on ordinary principles. But there are cases in which large nerve-trunks (e.g. the musculo-spiral, or the brachial plexus) are involved in and compressed by the callus, or by some detached fragment, and so the limb may be paralysed. Cases are on record in which this untoward event has been remedied by cutting away the superfluous bone, or callus, and freeing the nerve-trunk. Such a case was Ollier's,[4] in which the musculo-spiral nerve was liberated from pressure, and Délens',[5] in which the brachial plexus and subclavian artery were the parts compressed.

DISLOCATION.

The word 'dislocation,' when used by itself in surgical works, is intended to signify the forcible displacement of one articular surface of a joint from another. Other organs also are subject to dislocation; thus dislocation of the

[1] 'Med.-Chir. Trans.' vol. xlii. A most valuable paper on this subject.
[2] See Lister, 'Brit. Med. Journal,' Oct. 31, 1868, p. 462.
[3] 'Lond. Med. Record,' March 31, 1875, p. 198.
[4] 'Gaz. hebd.' 1856, p. 515. 'New Syd. Soc. Bienn. Retrospect,' 1865–6, p. 294.
[5] 'Lancet,' Nov. 19, 1881.

lens and of the testicle are spoken of, but in such cases the name of the displaced organ is always added. Dislocation of joints also occurs as a consequence of disease (pathological dislocation, frequent in the knee and hip), and sometimes as the result of malformation (congenital dislocation). Traumatic or true dislocation may be complete—i.e. where no portions of the two articular surfaces are in contact—or incomplete, when a part of one still remains applied to the articular surface of the other bone. When the bone, besides being dislocated, is exposed by a wound, the dislocation is said to be compound. It is universal in modern surgical works to describe dislocation as being of the more movable bone, or of that bone which is situated farthest from the trunk, but in the older writers this rule is not followed. Thus Sir A. Cooper described the dislocations of the ankle as being of the tibia and fibula, which are now described as dislocations of the foot. This difference of nomenclature of course reverses the direction in which the part is said to be dislocated, since a displacement which, if described with reference to the leg, is inwards, becomes outwards when the foot is said to be displaced.

General symptoms.

There are a few points which ought to be mentioned as concerning dislocations in general before the individual injuries are described. The signs of a dislocation are, loss of the natural shape of the part, loss of the movements of the joint, both active and passive, in different degrees, and alteration of the relations of the bony prominences to each other, together with an absence of the signs of fracture, when the dislocation is pure; but it is not uncommon for the dislocation to be accompanied by fracture of some bony process, or even of the shaft of the bone in the neighbourhood.

Reduction.

Having diagnosed the existence of dislocation, the surgeon's aim is to *reduce* it, i.e. to restore the displaced bone to its natural position. As a general rule all dislocations are accompanied by more or less laceration of the capsule of the joint,[1] of some of its special ligaments and of the muscles around it, while the muscles on one side are put on the stretch and those on the other side shortened. After a time the displaced head of the bone contracts adhesions to the other bones and to the parts around, and, especially where there has been much motion of the bones on each other, a kind of new articulation may be formed, while the old articular cavity may be more or less completely filled up. The obstacles to the return of recent dislocations depend on the resistance of the displaced muscles or ligaments, on the interlocking of the bones, or on the interposition of the capsule or some of its accessory structures between the dislocated bone and the cavity to which it is to be returned. Many of these obstacles are more easily overcome by appropriate manipulation than by force, so that dislocations of the hip, for which it used to be thought necessary to exhaust the muscular force by bleeding and antimony, and then to use violent extension by means of pulleys, are now usually reduced under chloroform with extreme facility by simply disengaging the head of the bone from its acquired position, when the muscles at once restore it to its natural place.

In old dislocations the difficulty of reduction depends on the formation of adhesions between the two bones, on the permanent contraction of the shortened muscles, and on inflammatory deposit filling up the old articular cavity, which sometimes renders the return of the bone impossible, and at others

[1] Mr. Eve describes a case of complete dislocation of the shoulder, in which the capsule was not lacerated, but stripped off the scapula together with the periosteum. 'Med.-Chir. Trans.' lxiii. 317.

even fills up the cavity altogether. The shape of the displaced bone itself also becomes altered by pressure or by inflammation.

As these difficulties increase very speedily in the first week or two after the injury, it is of the greatest importance to recognise the nature of the accident, and apply the appropriate remedy as early as possible. When a dislocation has existed for a very long time it is very doubtful whether its reduction is physically possible, or whether, if it were reduced, the limb would gain or lose in utility.

When a dislocation has been successfully and completely reduced the lacerated capsule and muscles quickly heal, and everything returns to a condition of health, the joint regaining its normal movements, and to a great extent its normal stability, but often not completely, for dislocated joints, and particularly the shoulder and the lower jaw, are very liable to renewed dislocation; and the oftener they are dislocated the weaker and more lax the capsule becomes, and the more easily may the dislocation be reproduced. And it must also be recollected that the laceration of the capsule in a dislocation is often very extensive—at least it seems so from experiments on the dead subject—and that the healing of an extensive rent in a structure so lowly organised as a thick aponeurosis must be a somewhat slow process; so that for a time which it is not very easy to calculate the laceration either remains unhealed or so weakly united that it may easily give way again. Hence the care which surgeons always exhibit to keep the joint at perfect rest for two or three weeks after a dislocation, and to enjoin on the patient great caution in movement and the wearing of some retentive apparatus for a considerable time after this. Want of care and sudden motion soon after a dislocation, even irrespective of any violence, will very often reproduce the dislocation, which, however, is always easily reduced. So also in old dislocations which are liable to recur, they are always reduced with proportionate facility.

Repair of injuries of cartilage.

It remains to say a few words as to the method of repair in wounds or fractures of cartilage. The method of union of fractures is best studied in those of the costal cartilages and those of the articular cartilage of the femur, which is so often involved in the fractures which run into the knee-joint. The uniting medium seems to differ somewhat in accordance with the different qualities of the cartilage involved. Thus the costal cartilages, which are naturally prone to ossify, unite very commonly by bone,[1] or by a mixture of bone and cartilage. Fracture of articular cartilage is usually very slow of healing, and the cartilage is found unchanged close to the seat of fracture; ultimately the breach of surface is usually repaired by a layer of fibrous tissue or by a mixture of fibrous tissue and cartilage.[2] In wounds of cartilage made for the purposes of experiment on the lower animals Dr. Redfern has

[1] In the Museum of St. George's Hospital are three specimens of fracture of costal cartilages (Ser. I. Nos. 67, 68, 69), all united by bone. Mr. Poland refers to three in St. Bartholomew's Hospital Museum, in one of which the union is entirely and in another partially bony, cartilage being mixed with the bone; in the third the fracture is repaired by the growth of a new cartilaginous substance.

[2] In the Museum of St. George's Hospital (I. 193) is the preparation of a fracture running into the knee-joint, received twenty-eight days before the patient's death. 'On the articular surface a thin layer of firm fibrine, of a light brown colour, is interposed between the cartilaginous margins of the fracture, the cartilage itself having as yet undergone no change.' A preparation, exactly similar to this, is figured in the section on fracture of the femur.

found that the resulting changes affect both the cells and the intercellular substance, though only to a slight distance from the seat of injury. They display a very strong tendency to heal without any further destructive changes, and this repair is brought about either by the production of fibrous tissue or by calcareous deposit leading to calcification of the entire cartilage. Dr. Redfern describes both the cells and the intercellular substance of the injured cartilage as taking part in the production of the fibrous tissue, the intercellular substance fibrillating and becoming replaced by a material exactly resembling white fibrous tissue, while the cartilage-cells increase in size, and their nuclei give place to a number of corpuscles. Then the wall of the cell becomes identified with the hyaline intercellular substance and the corpuscles are set free, and while the hyaline substance is becoming fibrillar and forming the white fibrous substance, the corpuscles are developed into the nuclear or elastic fibres.[1]

From these researches Dr. Redfern concludes that 'uncomplicated lesions of cartilages (especially such as have been artificially produced in the lower animals) manifest a very decided tendency to spontaneous cure by the production of fibrous tissue, or by calcification of the whole cartilage left after the injury;' and that the 'diseased action arising from circumscribed destruction of the articular cartilages of the lower animals evinces no tendency to extend to the remaining parts of these textures, nor to involve other structures, and lead to serious disease of the joint.'

Uncomplicated lesions of cartilages are of course very rare in the human subject, but the examination of specimens such as that above referred to from St. George's Hospital Museum leads us to believe that Dr. Redfern's conclusions are true in the main when applied to the human subject; that is to say, that cartilage is prone to repair, and that the disease produced in it by traumatic injury rarely extends far from the part injured.

[1] Redfern. Anormal nutrition of cartilage, pp. 67 et seq.

CHAPTER VII.

INJURIES OF THE HEAD.

Serious results sometimes follow trivial injuries.

INJURIES of the head are matters of equal importance and interest. It is an old and good rule in surgery 'never to look lightly on any injury of the head, however trifling it may appear.' Very grave anatomical lesions may have been produced by injuries which appear trivial. Cases are recorded in which a weapon has passed deeply into the brain, through the papery bones of the orbit, and has left a fragment there, and the man has gone about his business thinking he had only received a scratch on the eyelid, till inflammation of the brain has set in, and the foreign body has been found after death.[1] So, again, a slight tap on the skull may possibly cause rupture of a large vessel or laceration of the brain, followed by fatal hæmorrhage or inflammation. And again, lesions really very slight in themselves may be followed by the most alarming and even fatal consequences. I once saw a man who was in hospital for a small sebaceous tumour of the scalp. The surgeon under whose care he was had forgotten the case and overlooked the man for some days. One day he happened to come into the ward where the man was sitting, who got up and reminded him of his inadvertence. The surgeon apologised, took out his pocket-case, made a little incision, and squeezed out the tumour in an instant. The patient thanked him and went to his seat again. But in ten days he was dead of pyæmia. And everyone must have seen, both in public and private practice, cases in which very slight injuries of the head have set up frightful attacks of erysipelas, or have been followed by brain-symptoms quite disproportionate to their apparent gravity. Therefore, though these unfortunate cases are comparatively rare, they must be borne in mind as an argument for caution in the treatment and some reserve in the prognosis.

Classification of injuries.

Injuries of the head may be thus divided:—i. Simple contusion of the soft parts. ii. Scalp-wound (*a*) without exposure, and (*b*) with exposure of bone. iii. Extravasation of blood beneath the skull-cap. iv. Fracture of the skull, simple or compound, and either of them with or without depression of the fractured bone. v. Injury, i.e. contusion or laceration, of the brain and its membranes. vi. Injuries to the nerves.

Complications.

The inflammatory complications of such injuries are erysipelas and diffuse inflammation of the soft parts, suppuration within the skull, inflammation of the brain and its membranes, and Hernia cerebri.

Surgical anatomy of the scalp.

It may be well, in commencing this subject, to recall the reader's attention to the main peculiarities in the surgical anatomy of the scalp. They are as follows:—

1. The skin is intimately connected to the tendon of the occipito-frontalis (which here represents what in other regions of the body is the muscular fascia), instead of being separated from it by cellular tissue.

2. The larger vessels lie immediately beneath the skin, i.e. between it and the tendon, instead of under the fascia, as in other parts.

[1] Several such cases have been published: in one case it was the end of a walking-cane with which a soldier was fencing with his comrade; in another the ferule of an umbrella which a testy old gentleman poked into the eye of a man who ran against him in the street.

3. The tendon of the occipito-frontalis is loosely united to the pericranium by very extensile cellular tissue, and is perforated by small arteries, which run from the larger vessels, through the cellular tissue, to nourish the pericranium.

Consequently (1) wounds of the skin almost always involve the tendon also; (2) bleeding from the large arteries is generally easily commanded, in consequence of their superficial position; (3) in diffuse inflammation of the scalp the thickness of the part is often enormously increased by extravasated lymph, and such extravasation will very probably strangulate the vessels nourishing the pericranium.

Contusion of the soft parts.

I. *Contusion* of the scalp gives rise usually to a little 'bump' of extravasated blood; but in children it is not uncommon to find huge extravasations which may sometimes extend over the whole, or over one side, of the head, and which I have known mistaken for abscess the result of disease of the bones. But the uninflamed condition of the scalp and the history (if this can be obtained) will sufficiently guard against such a mistake. These collections of blood and fluid are bounded by a ridge or border formed of condensed tissue and blood-clot. In smaller contusions this ridge is very often confounded with a fracture; and it must be allowed that, in some cases, the diagnosis is not an easy one. But generally the contusion may be recognised as such by the following characters: the ridge is elevated above the level of the neighbouring sound skull, its edge is somewhat rounded, its outline regular and usually crescentic, and, by pressing the finger-nail upon it, an impression may perhaps be made. The apparent depression within the ridge will probably yield sufficiently to the pressure of the finger to allow the surgeon to feel the sound skull below it. In fracture with depression, on the other hand, the ridge which appears elevated is really on the same level as the rest of the skull; its margin is sharp and irregular, and its direction very variable. If in the depressed part any bone can be felt, it will most likely be loose.

Diagnosis of extravasation in the scalp from fracture.

The only question of treatment which occurs is in the large extravasations of childhood. In these cases the extravasation is situated between the pericranium and occipito-frontalis tendon—not beneath the pericranium, as in cephalæmatoma,[1] and therefore it may increase to any size; and I have heard of (but not seen) a case in which pulsation was present in it, communicated from the temporal artery. If hæmorrhage is going on actively it may be justifiable to cut down and look for the wounded vessel, but I never saw a case in which there was the slightest justification for such a measure. In the instance in which the temporal artery was injured it was tied at a healthy part successfully. And in a case where no perceptible improvement followed from prolonged expectant treatment it would be right to draw off the fluid with an aspirator. But generally, with patience and the use of a slightly stimulating lotion or embrocation (such as Lot. Ammon. Hydrochlor. gr. x : ℥j; or Tinct. Arnicæ ℥. i., Aquæ ptes. iv.–vi.; or Liniment. Ammoniæ), the fluid is gradually absorbed, and the part returns to its natural size and appearance. If the surgeon has been tempted to puncture such a collection he should close the puncture at once and apply pressure, being ready, on any appearance of suppuration, to open it freely.

[1] Cephalæmatoma is the name given to a blood-tumour produced on the skull of the infant during birth by the pressure of the uterine walls. It is treated of in works on Obstetrics.

Scalp-wound.

II. Scalp-wounds are generally contused, and in severe cases heavy flaps hang down, which are very difficult to keep in place. Sometimes the scalp is ground to pieces by the passage of a wheel; and very often in scalp-wounds foreign bodies (dirt, stones, hair, straw, &c.) are embedded. The bone is very often exposed, and not exposed merely, but is usually also cut, bruised, or rasped to a greater or less extent,[1] and foreign bodies may even be embedded in it. A case occurred many years ago at St. George's Hospital in which a man was sent up from a distance with a scalp-wound neatly united over a portion of brick which had been driven into the skull. This being broken off on the exact level of the skull was mistaken for a piece of exposed bone.

There is not very often formidable bleeding in scalp-wounds, for the reason above stated. At least, though active at first, it generally soon subsides; nor is there much difficulty in commanding it if it should not. If the arteries are too much contused to be tied or twisted they can easily be compressed, or, in the last resort, be commanded between an acupressure-needle thrust in below them and a ligature above. Bleeding having been stopped, and all dirt and foreign bodies carefully and gently removed, the wound must be united. There is an old traditional horror of sutures in scalp-wounds which seems to me, to say the least, exaggerated; and I never hesitate to use silver sutures when there is any difficulty in keeping the wound in apposition. There is no necessity for putting them in deeply, so as to wound the tendon, and therefore no justification for doing so. The wound should then be so dressed as in the opinion of the surgeon is best calculated to produce its rapid union (see DRESSING OF WOUNDS); for in every scalp-wound, whether bone be exposed or no, and whether that bone be fractured or no, rapid union is the main point by which the patient's safety is ensured. But closing a wound which must be reopened afterwards for the discharge of sloughs, or grit, or retained matter, tends to retard instead of hastening its ultimate union; so that in such cases it is better to leave the wound open under poultice or water-dressing. Often, when the lips of the wound are healthily granulating, but the bone is exposed below, great advantage may be obtained by bringing the granulations in gentle apposition with straps or sutures, and sometimes entire 'secondary adhesion' will thus be obtained. I have often watched large exposed bony surfaces to see how much of them would die, have frequently been both pleased and surprised to see that no necrosis at all has taken place, but the whole exposed bone has been covered in by granulations; at other times only a minute scale of bone has exfoliated. Things, however, do not always go on thus kindly, and the scalp-wound may easily prove the starting-point of caries or necrosis of the bone.

Complications—erysipelas.

The usual complications of scalp-wounds are erysipelas, either of the common or of the cellular variety, and suppuration within the cranium. Cutaneous erysipelas is, I think, the rarer form. It extends to the face, and requires only the ordinary treatment. The treatment of the cellular form is a more serious problem. The inflammation originates in lesion of the cellular tissue between the tendon and the pericranium, and extends often with great rapidity over the whole head, causing immense œdema, and leading ultimately to sloughing both of the scalp and pericranium.[2] It begins with puffiness and slight redness around the wound, but as the inflammation is almost confined to the cellular

[1] On the consequences of contusion of the cranial bones in scalp-wounds I would refer the reader to a paper by Dr. Lidell in the 'Am. Journ. Med. Sc.' October, 1879.

[2] In one case where no incisions were made I saw the whole vertex of the skull exposed by sloughing as cleanly as if the man had been scalped by a Red Indian.

tissue the redness is not usually at all vivid. The œdema extends from the wound, accompanied with pain in the head, and general fever, ushered in usually with rigors, which may recur more or less frequently; the pulse is rapid and often weak: the tongue white, with glazed edge. Matter forms after a day or two, and the bone is often exposed in places by the destruction of the pericranium. Burrowing of matter as the result of scalp-wound is easily to be distinguished from the œdema and boggy feeling of cellulo-cutaneous inflammation, since it is confined to the neighbourhood of the wound and gives rise to far less severe symptoms. Nothing here is required usually, except to give an exit to the burrowing matter, and perhaps pass a drain through from the wound to the opening so made.

Patients attacked with cellulo-cutaneous erysipelas generally, or at any rate frequently, are those whose constitution is broken down by intemperance, privation, or disease, and such a case is therefore to be looked upon always with anxiety. They seldom bear depletion, or even deprivation of nourishment or stimulants, so that anything like copious loss of blood is to be deprecated. Still, if the parts are tense and the œdema is rapidly advancing, it is absolutely necessary that incisions should be made, and that boldly and decisively. For the patient will ultimately save blood by having to submit to the incisions only once, rather than be obliged to bear a repetition of what is a very painful and depressing operation. Excluding, then, the general treatment of the case, which must be conducted on the principles laid down in the section on ERYSIPELAS (page 45), and which in our hospitals always tends strongly to the supporting and stimulant method, we will consider only the local treatment, and mainly the question of incising the scalp. I have seen cases, somewhat threatening at first, brought to a successful issue without any incisions; so that unless the œdema is unusually acute I should dissuade any hurry at first. In the first place, the whole scalp, or at any rate all the puffy part of it, must be cleanly shaven. The original scalp-wound must be laid open freely, which is done with the least pain by passing the finger into it down to the bottom and from end to end, and then a warm poultice should be applied to encourage discharge and relax the parts, or the head should be fomented with warm lead-and-opium lotion or decoction of poppies. If this fails to check the œdema, which is nevertheless not very great, or accompanied with much tension, a crop of lancet-punctures may be made. When incisions are manifestly necessary they must be made boldly down to the bone, and to a sufficient extent to ensure the relaxation of all the tense tissues. But no one incision should be of any great length, since otherwise some large vessel must necessarily be injured—about 1½ to 2 inches is the limit for each incision. They should run directly from before backwards, and any large vein which is seen under the skin should be avoided. If much arterial hæmorrhage occurs it must be checked before the patient is left. Sometimes the bleeding vessel is easily twisted or tied, and occasionally it is found that an artery has been partially divided at one end of the incision, which will cease bleeding when the incision is so far extended as to complete its division. But if the arteries continue to bleed, yet the surgeon cannot find them in the mass of inflammatory exudation, the wound should be stuffed with lint, on which pressure may be made till all tendency to hæmorrhage has ceased. The lint may be removed in a few hours, and the incision will answer its purpose as well as if it had been left open from the first. A poultice afterwards is the best dressing.

Intracranial suppuration.

A still more formidable complication of scalp-wounds and other injuries of the head is the formation of pus in the interior of the skull. Left to itself

such suppuration is necessarily fatal, and unfortunately we possess only very imperfect means of treating it. The cause of intracranial suppuration is more commonly a scalp-wound with exposure of the bone than any other injury, though any other injury may be followed by this complication. As ordinarily occurring the sequence of events is this: the skull-cap is exposed, and its external table more or less contused or rasped. This is followed by inflammation of the bone, effusion between it and the neighbouring uninjured periosteum, forming a 'puffy tumour' around the injured part; inflammation of the diploic tissue and of the internal table, and inflammatory effusion followed by suppuration between the bone and the dura mater. Inflammation may also be propagated to the arachnoid cavity, to the subarachnoid space, between the hemispheres and the falx cerebri, to the tissue of the brain or to its ventricles. Finally, the inflammation of the diploe, and of the large venous sinuses which it contains, may prove the starting-point of general pyæmia. It is obvious that some of these conditions are incurable, and others can only be cured in the rarest cases. Abscesses in the brain have been successfully opened,[1] and they are usually at least, if not always, limited. Suppuration spreading along the meshes of the pia mater or down the falx cerebri is generally too much diffused to allow of any adequate exit being given to it. Abscess in the arachnoid cavity has been found limited, and has been successfully opened.[2] But when the surgeon diagnoses and attempts to open an intracranial abscess his hope is to find a limited collection of matter between the bone and the dura mater. It was to the occurrence of these limited abscesses immediately beneath the cranium that Mr. Pott[3] drew the attention of the surgeons of his day, and he dwelt strongly on the 'puffy tumour' (since commonly called after his name) as a valuable indication of the subjacent suppuration. Mr. Pott was so fortunate as to meet with eight cases suitable for the application of the trephine, of which five recovered. Modern surgeons have been far less fortunate—in fact, the cases of recovery after trephining for pus in this country are very few indeed within living memory. Some years ago I published the experience of St. George's Hospital in this particular for seventeen years—1841 to 1857 inclusive.[4] Eight cases occurred in which the trephine was applied for pus. The pus was found in every case, but all the patients died. Seven were examined after death, and in six of these unmistakable evidence of phlebitis in the sinuses of the brain and veins of the skull and of general pyæmia was discovered. In the seventh case the abscess reached the ventricles of the brain. There were eight other cases in which the trephine was not used, and where matter was found above the dura mater; but it was not limited to this situation in any of these cases, nor could adequate exit have been procured for it by the trephine. In nine other cases there had been intracranial suppuration, but the matter was diffused among the membranes or in the substance of the brain, and lay entirely below the dura mater.

Taking this as a fair specimen of what the surgeon is likely to meet with, it goes far to explain the hesitation which is usually displayed in recom-

[1] The latest published cases which I have met with are Mr. Holden's ('St. Bartholomew's Hospital Reports,' vol. ix.) and Mr. Hulke's 'Med.-Chir. Trans.' vol. lxii. Others will be found referred to in Mr. Hewett's and Mr. Hulke's essay on Injuries of the Head, in the first volume of the 'Syst. of Surgery,' 3rd ed.

[2] Dumville, 'Brit. Med. Jour.' 1858, vol. ii. p. 743. Roux, 'Archives Générales,' vol. xxiv. p. 268.

[3] Injuries of the Head, 'Chirurgical Works,' vol. i. pp. 38 et seq.

[4] 'Brit. Med. Jour. Oct. 16, 1858.

mending an operation for intercranial suppuration. Yet, as the operation is really the only chance for the patient's life, it is certainly the duty of the surgeon to give him that chance whenever there are clear indications of limited suppuration. We must, therefore, study carefully the symptoms of this condition.

Suppuration beneath the cranium commences usually a considerable time after the injury—about a fortnight may be taken as an average—with pain in the head, possibly an unhealthy appearance of the wound, feverishness, vomiting, rigors, delirium, muscular spasms, and finally coma, terminating in paralysis. The presence of the puffy tumour is a valuable indication, but it is by no means common to find it, probably from the free laceration or destruction of the pericranium which accompanies these injuries.

The treatment at first must be antiphlogistic. A free discharge must be promoted from the wound, which should be laid completely open for that purpose, and which should of course be then very carefully examined, and the state of the bone ascertained as far as may be. Leeches to the shaven scalp or to the temples should be applied, if the heat of the head and the beating of the arteries of the scalp seem to call for them. Mercury in small and frequent doses may be useful at the commencement of the inflammatory symptoms, though its administration cannot be recommended when the symptoms clearly indicate that suppuration is established, which may always be safely concluded when the symptoms of traumatic inflammation have lasted over forty-eight hours, accompanied with rigors and sweats. In cases where the pulse is weak, stimulants must be combined with the antiphlogistics. Ice to the head and perfect quiet in a darkened room are essentials in the treatment of traumatic inflammation after injury to the head. When the symptoms of suppuration are followed by those of compression of the brain, and especially when paralysis is clearly marked, the question of trephining occurs. And now it becomes essential to distinguish, if possible, between the symptoms of local pressure on the surface of the brain, as from a limited collection of pus above the dura mater, or an abscess encysted in the arachnoid cavity, and the symptoms of general pressure on the brain produced by an extensive accumulation of pus in the subarachnoid space, or running along the falx down to the corpus callosum, or in the substance or ventricles of the brain. This is unluckily a very hard problem. The symptoms which most clearly mark general pyæmia are repeatedly recurring rigors, the elevated yet varying temperature, the rapid emaciation, the feeble rapid pulse, the profuse sweats, and the changed complexion known to accompany this condition, while the head symptoms are probably more or less indefinite. If external abscess or internal inflammation (pneumonia more probably than any other) should supervene, the diagnosis will be certain. It must be remembered, however, that cases of intracranial abscess are by no means uniform in their symptoms, even apart from any pyæmic complication, and that large collections of matter have been found even external to the brain and still more frequently internal to it, the symptoms of which during life have been very obscure.[1] So that, looking to this fact and to the otherwise hopeless nature of the case, I think it is reasonable

[1] See a case in Mr. Hutchinson's 'Illustrations of Clinical Surgery,' Pl. xxxv., of death from an immense collection of pus between the bone and dura mater, in which the symptoms were rather those of headache and irritation than of paralysis. Here, however, the abscess was slowly formed, due to disease of the bone, and had had an imperfect vent through the skull till some unknown period before death. In the same work (Pls. xviii.–xxi.) the reader will find excellent illustrations of several of the forms of intracranial inflammation after injuries of the head.

to incline rather to the side of operative interference in doubtful circumstances. Those cases are the most appropriate for trephining in which with exposure of a portion of the skull-cap there is paralysis definitely limited to the opposite side of the body, and no suspicion of general pyæmic infection. In such cases the denuded bone should be fully exposed by incision; and if one part of it looks more grey in colour than another the trephine should be applied there; or if the puffy tumour exists it must be cut into and the trephine applied on that spot; otherwise it must be placed on any part which the surgeon chooses. If (as is often the case) matter wells up while the diploe is being sawn through, it is a bad sign, for in such cases the pus is hardly ever confined to a single locality. In some rare cases the sequence of events described by Pott takes place, i.e. a circumscribed collection of pus is opened by the removal of the crown of the trephine, and the paralysis is at once relieved. Or the dura mater may bulge into the trephine-hole, destitute of pulsation, and possibly showing the matter below it. A puncture should in such a case be made into the dura mater. In other cases, again, after the dura mater has been incised no matter escapes, but the surface of the cerebrum is driven up into the hole; and then it is justifiable to make a small exploratory incision into the brain, and if pus is found to give it an adequate exit.[1]

I ought to add that the symptoms of pressure following on inflammation of the brain after injury have in two recent cases led the surgeon to apply the trephine where no matter was discovered, and in both cases recovery ensued. I was myself the surgeon in the one case, and Mr. Joseph Bell in the other.[2] The symptoms in my own case were certainly very definite, and must have been due, I conclude, to effusion of lymph beneath the dura mater,[3] which was relieved by the removal of the skull-cap.

Extravasation between the bone and dura mater.

III. Extravasation of blood as the result of injuries to the head may occur in one or more of the following situations: (1) External to the cranium; (2) between the bone and dura mater; (3) in the arachnoid cavity; (4) in the substance of the brain.

1. Extravasation in the scalp has been treated of already (p. 133).

2. Extravasation between the bone and the dura mater depends either on laceration of the middle meningeal artery, of the lateral or possibly some other

[1] In an interesting paper on the diagnosis and operative treatment of compression of the brain ('Am. Jour. Med. Sci.' July 1873), Dr. Gross attempts to distinguish between the symptoms of suppuration—1, above the dura mater; 2, amongst the membranes; and, 3, in the substance of the brain—premising, however, that there are many cases in which suppuration occurs in several different parts at the same time. The first is marked by its comparatively early occurrence, 6th–16th day; by the presence of the puffy tumour, and by the less marked character of the spasms and paralysis; the second by a somewhat later occurrence, 8th–21st day; the puffy tumour is only present when the suppuration is limited within the sac of the arachnoid; the muscular spasms and unilateral hemiplegia are strongly marked; the third takes place later, 13th–27th day, sometimes even months after the injury; there are no changes about the wound, and the coma and paralysis are much less complete. Further experience is necessary to show what trust is to be reposed in these diagnostic differences; but I quite believe that as a rule suppuration within the brain comes on at a later period and with less definite symptoms than does suppuration limited to the membranes. See the abstract of this paper in the 'London Med. Record' for Oct. 15, 1873.

[2] My case is alluded to in 'St. George's Hospital Reports,' vol. vii. p. 278. Mr. Jos. Bell's case is somewhat more fully reported in the 'Edin. Med. Jour.' Aug. 1873.

[3] Mr. Hutchinson, op. cit. vol. i. p. 70, believes that hemiplegia is more universally and necessarily associated with arachnitis than with mechanical pressure. If this be true, the mere occurrence of hemiplegia does not necessarily involve any indication for trephining; but in a case in which it follows on clearly marked symptoms of intracranial suppuration it certainly justifies the operation.

sinus, or of smaller vessels passing between the bone and dura mater. The symptoms of compression from this cause (when they are sufficiently definite to permit of diagnosis) come on after an interval of complete or incomplete consciousness. This interval, in a well-marked case which occurred many years ago at St. George's Hospital, was about an hour; but it has been known to be as much as four hours or more, the period varying of course with the circumstances of the patient, whether he is at rest or in motion, quiet or agitated, sober or drinking, &c. The symptoms of compression usually advance rapidly, and in well-marked cases soon culminate in hemiplegia.[1] When this is the case it is an indication, even in the absence of any history or mark of injury, which justifies the surgeon in cutting down (on the side opposite to that paralysed) on the large branch of the middle meningeal artery which crosses the anterior inferior angle of the parietal bone, since this is the vessel most frequently lacerated. This point is easily found by making a horizontal incision running through the temporal muscle, about an inch above the zygoma, and commencing about half an inch from the external angular process of the frontal bone. The fibres of the muscle are to be turned off from the bone, and the surgeon is to look for the line of fracture. If this is found a crown of trephine is to be removed, and the blood-clot will, it is hoped, be brought in sight. The clot is to be picked away and the vessel sought for; in doing which it may be necessary to remove more of the skull. When the wounded artery is exposed it may cease to bleed, otherwise it is easy to secure it, either by torsion or by a minute silk ligature; or, if it is found to lie in a canal in the bone, by stuffing the hole with wax or lint. But the hæmorrhage may proceed from other sources. Thus in the case referred to, at St. George's Hospital, it was not the middle meningeal artery but the lateral sinus that was wounded. The surgeon cut down on the situation of the artery; but the incision not having extended backward quite far enough to expose the fracture, the source of the bleeding was only discovered after death. Remembering this case, then, the surgeon should be prepared, if necessary, to expose the posterior inferior angle of the parietal bone also. Again, a case is recorded[2] in which the trunk of the middle meningeal artery was lacerated in the foramen spinosum. And there are cases in which the symptoms are due, not to the laceration of any known vessel, but of several unnamed branches passing from the dura mater to the bone. Here, however, the known situation of the injury must be the surgeon's guide in applying the trephine. But the greatest difficulty in the treatment of these cases is that very similar symptoms may follow on rupture of vessels in the interior of the brain from laceration of the cerebral substance. Nevertheless, as the symptoms of unilateral compression of the brain coming on after an interval from the injury do undoubtedly often depend on the lesion of an accessible vessel, the trephine should unquestionably be applied in such cases, and all the more if any fracture is perceptible externally. But the operation is not by any means a successful one. Dr. Gross, speaking only of the injuries received in warfare, has collected seven

Trephining for wound of middle meningeal artery.

[1] Hemiplegia is not by any means a constant symptom in compression from extravasation of blood. Mr. Hutchinson has given one striking example (op. cit. Pl. liv.) and referred to others in which it was absent. This seems to depend on the gradual occurrence of the bleeding. In cases also where the bleeding is very rapid, the hemiplegia, which doubtless is present, may be masked by the unconsciousness of the patient, and when present it is often very imperfect. So that the absence or incompleteness of hemiplegia is not a complete contra-indication for trephining in cases in which unconsciousness comes on after an interval, and where the patient seems likely to sink if unrelieved.

[2] Gross, 'Am. Journ. Med. Sci.' July 1873.

cases in which the anterior branch of the middle meningeal was the wounded vessel, of which one recovered, and seven in which the hæmorrhage proceeded from the small vessels of the dura mater. Five of these recovered; but, in the absence of the histories, it may be permissible to doubt whether the operation is absolutely necessary in such lesions as those in the latter class. The only successful case that I can myself remember to have seen was one in which the vessel was injured by a spike-wound, and where the hæmorrhage having some exit externally the usual symptoms of compression were absent.[1] So in figure 39, the fracture being widely open, the blood passed freely into the tissues of the scalp, and no symptoms of compression occurred.

Extravasation in arachnoid cavity, blood membranes and cysts.

8. Extravasation into the arachnoid cavity is a very common result of injury. It forms a layer of blood-clot which soon becomes decolorised, and is ultimately replaced by a thin membrane, looking like a doubling of the arachnoid, or consisting in some cases of numerous layers. The layers may be continuous, forming a closed sac full of fluid, as in the case which furnished the illustration (fig. 41).

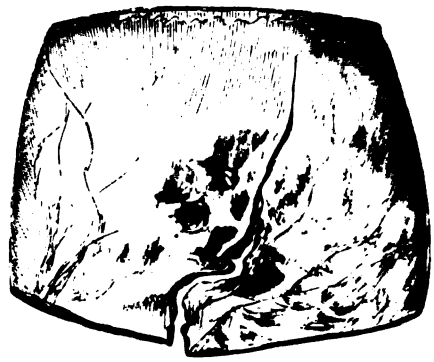


FIG. 39. The parietal bone of a child æt. 5, showing a gaping fissure which crosses the groove for the middle meningeal artery, producing considerable extravasation inside the skull (the traces of which are still visible) and still more hæmorrhage externally. The child was admitted a week after the accident with a large blood-swelling above the ear, but without any cerebral symptoms. On the fourth day after admission symptoms of meningitis commenced, and he died comatose four days afterwards. The sub-arachnoid cellular tissue was found infiltrated with purulent fluid.—St. George's Hospital Museum, Ser. I. No. 4.

In this case there had been an injury to the head by falling out of a cart in a state of intoxication three years before death. The patient was said to have been insensible for half an hour, but then recovered consciousness, and was removed to his house, a distance of five miles. He complained much after this of pain in the head and neck, was irritable and depressed, and his memory was not so clear as before. But he displayed no very distinct symptoms till a year after the injury, when he had a fit of insensibility, without convulsions, followed by some numbness of the left side and a discoloured appearance of the left arm and leg. Such seizures became afterwards common with him; but his death was due, not to cerebral causes, but to disease of the heart. The cyst was found lying quite loose on the surface of the right hemisphere, and rolled out as soon as the skull-cap was divided. It consisted of fibrous tissue without any obvious blood-vessels, and contained a grumous fluid, the remains of extravasated blood.

The origin of the false membranes found in these cases has been the subject of much discussion. John Hunter and the pathologists who followed him believed firmly in the organisable properties of blood; others believe that extravasated blood is never organised; but that such extravasation provokes the effusion of organisable lymph from the vessels of the neighbourhood, and that during the process of organisation of such lymph the blood itself is absorbed.[2]

[1] In some cases of compound fracture the common carotid artery has been tied with success for uncontrollable bleeding from the arteries of the membranes. See Lidell ('Am. Jour. Med. Sci.') April 1881, p. 345.

[2] On the whole of this subject see Mr. Hewett's paper, 'Med.-Chir. Trans.' vol. xxviii. p. 45.

Both processes really seem to exist. The first step in the formation, both of the cysts and false membranes, is that the blood-clot is covered on its free surface with a semi-transparent, soft, jelly-like, false membrane, which speedily takes the form of the serous surface; but the whole clot and false membrane can at this period be easily stripped off the true serous membrane below. A similar false membrane can sometimes be traced uniting the clot to the parietal serous surface. These membranes appear to be really inflammatory products from the vessels, though unaccompanied by any general symptoms of inflammation. But that organisation does go on in the extravasated blood itself is



Fig. 40. The inner surface of the dura mater, showing a large quantity of blood extravasated and adhering to its arachnoid lining. This has become decolorised to a great extent, and begun to assume a membranous form. The dura mater itself and the longitudinal sinus are natural. There was some blood extravasated also on the external surface of the dura mater.

The preparation was removed from the body of a patient who had laboured for some days under symptoms of compression of the brain, the result of disease. The remains of the extravasated blood have been peeled off from the surface of the arachnoid at the upper part.—St. George's Hospital Museum, Ser. viii. No. 64.

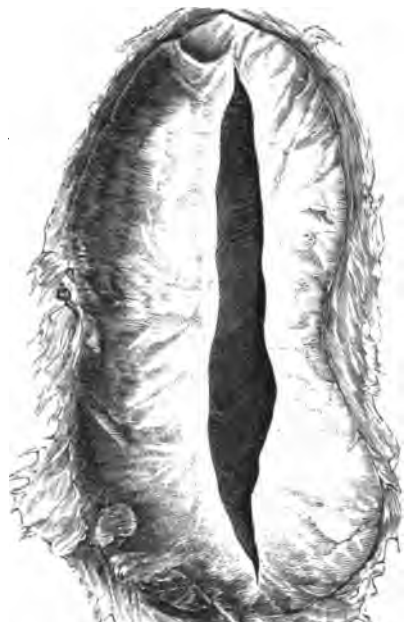


Fig. 41. Drawing (half the size of life) of a cyst removed from the cavity of the arachnoid, which originated in hæmorrhagic effusion consequent on an injury received more than three years before. The drawing is from the 'Path. Trans.,' vol. vi. plate 2.—The preparation is in St. George's Hospital Museum, Ser. viii. No. 81.

the opinion of many of the most eminent pathologists, among whom Rindfleisch may be referred to as having, as he believes, demonstrated how the red corpuscles of the effused blood are either converted into or replaced by the 'wandering leucocytes,' which are afterwards to form the fibrillar base of the new tissue.[1]

Symptoms of traumatic extravasation in arachnoid cavity.

The symptoms of these extravasations are not clearly made out, nor does it seem at all certain that they produce any symptoms of their own, if the effused blood is not in large quantity. In some cases (as in the one above quoted) there have been anomalous symptoms of slight pressure or slight irritation of the convolutions, such as persistent pain, loss of mental power, alteration of temper, fits. When very thick such effusions may cause more decided symptoms of compression, for which sometimes the trephine has been applied; the dura

[1] Rindfleisch, 'Path. Hist.' vol. ii. p. 322. New Syd. Soc.'s Trans.

mater having bulged into the opening has been incised, and the blood having been evacuated the patient has done well.[1]

Symptoms of traumatic extravasation in brain. Diagnosis of apoplexy.

When traumatic extravasations of blood, whether in the arachnoid cavity, in the meshes of the pia mater, or in the brain, are sufficiently large to produce symptoms of their own, those symptoms are so exactly like those of apoplexy that if the history is unknown or concealed, and there are no visible traces of injury, I am not aware that the diagnosis can be securely established. As this is a matter of very great medico-legal interest I must refer the student for a confirmation of this statement to our best authors on Medical Jurisprudence.[2]

Fig. 40, taken from a case of spontaneous extravasation of blood in the arachnoid cavity, is one of a series of preparations in the Museum of St. George's Hospital which show that such extravasations possess exactly the same anatomical characters, and become organised in exactly the same way as the traumatic extravasations. In fact, their symptoms, as well as their anatomy, are identical, and when no marks of violence are found, the cases are indistinguishable. And it is by no means rare for extensive lesions inside the skull to be caused by traumatic injuries which leave no trace on the scalp or the skull. I remember a remarkable instance which occurred while I was Curator of the Museum at St. George's Hospital. A woman was admitted in a state of almost complete insensibility, from apoplexy, as was supposed, under the care of one of the physicians. She was said to have had a fit two or three days before. She died on the following day. The head was carefully examined, and especially with a view to detection of any mark of violence. No trace of injury was found, no bruise, no fracture, no laceration of any part of the brain. The whole of one hemisphere was covered with an enormous quantity of blood, external to the brain, and chiefly in the meshes of the pia mater. Microscopical examination of the vessel did not enable me to detect any disease of their coats. The case was, in the absence of any further information, classed as one of meningeal apoplexy, and the woman had been buried, when the medical man who had attended her before her admission informed us that her death was attributed to violence on the part of her husband. It turned out that both of them were very drunken people, and that finding her drunk on his return home he had beaten her, and then left her locked up in a room for the greater part of a day. The body was exhumed, and the man put on his trial for murder; but, though the circumstances were suspicious, it was found impossible to come to any certain conclusion, and he was acquitted. For, notwithstanding the apparently healthy condition of those vessels which were examined, it was impossible to affirm that constant intoxication might not have given rise to apoplexy in this case; especially since cases of meningeal apoplexy have been put on record where no suspicion of violence could be entertained, and where no disease of the vessels was detected.

4. So it is with extravasation of blood in the substance of the brain. It is, to say the least, excessively difficult in many cases to say, with any approach to certainty, whether it depends on injury or on disease, or on a mixture of the two, i.e. on slight injury acting upon tissues degenerated by disease.

Fracture of the vault of the skull.

IV. We come now to fractures of the skull—divided into those of the vault and those of the base. The chief varieties of fracture of the vault are simple fissures, starred and comminuted fractures, fractures with depression

[1] Hewett, in the 'Syst. of Surg.' vol. i. p. 579, 3rd ed.

[2] 'The symptoms of traumatic compression, when well-marked and uncomplicated, are those of apoplexy.' Le Gros Clark, 'Diagnosis of Visceral Lesions,' p. 121.

of the entire thickness of the skull, fractures with depression of the outer or of the inner table only, and fractures with elevation of the fractured portion. In young subjects it is said that the skull may be indented or driven in (as any soft substance might) without any fracture, but this is doubtful.[1]

Any of these forms of fracture may be either simple or compound. In the injuries which we usually meet with in civil practice fissured fractures frequently spread from the vertex far into the base of the skull, and sometimes travel vertically round the whole cranium, so as to separate the anterior completely from the posterior part. Compound fractures may be said as a rule to be more often of limited extent than simple.

Depression of one table only. Fracture of frontal sinus.

Fractures with depression of one table only, and elevated fractures, are rare. The other varieties of fracture of the skull are of constant occurrence. Fractures with depression of the outer table only are best exemplified by those which occur in the frontal sinus, where a great depression may exist in the outer wall of the sinus without its inner wall having been in any respect interfered with. Such cases are easily known by the free escape of air out of the sinus, leading to considerable emphysema, and by the absence of brain-symptoms, in spite of the extensive depression.[2] Fractures with depression of the internal table only are rare, and their diagnosis very obscure. The Museum of St. George's Hospital contains two very well-marked specimens ;[3] and there is another specimen showing the skull-cap, from which a portion of the depressed inner table had been removed a year after the accident, but the patient died of arachnitis. This injury may be suspected, though it cannot be exactly diagnosed, from the continuance of constant pain in the part,



Fig. 42. A fracture passing vertically round the skull, so as to divide it into two portions, anterior and posterior. The line of fracture can be traced from the vertex, where it follows pretty nearly the course of the coronal suture to the base, where it becomes comminuted, the chief branch passing through the body of the sphenoid bone and extending into the sphenoidal fissure on the left side, while another large branch traverses the basilar portion of the occipital bone, just in front of the foramen magnum. The petrous portion of the left temporal bone is quite isolated. *a*. The foramen magnum. *b*. The basilar portion of the occipital bone. *c*. The foramen ovale. *d*. The sella turcica. St. George's Hospital Museum, ser. i. No. 6.

[1] I mean that it is doubtful whether the indentations which are occasionally found in the skulls of children are not always accompanied by some amount of fracture. The occurrence of such indentations and their gradual disappearance is undubitable. See in Mr. Le Gros Clark's work, p. 24, a very characteristic case in a baby six months old, caused by falling on a stone. 'The indentation was oval, about three-quarters of an inch deep in the centre; the end of the thumb might easily have been buried in it; it presented no sharp edge to the touch.' There were no head symptoms. Mr. Clark saw the child several years afterwards, and there remained no trace of the injury.

[2] A very well-marked case of fracture of the outer table only, from the blow of a bludgeon, in which the fractured portion ultimately separated, is related by Mr. Le Gros Clark, p. 91.

[3] Series I., Nos. 7 and 8. One of these is figured in Mr. Hewett's article on 'Injuries of the Head,' 'Syst. of Surg.,' 3rd ed. vol. i. p. 581.

accompanied with symptoms of imperfect compression of the brain, or followed by low inflammation of the membranes; and in such cases the trephine may be applied over the seat of injury, if the symptoms are grave enough in the judgment of the surgeon to warrant so serious a measure. The accidents which usually give rise to this injury are blows or cuts with a moderately sharp substance, a sabre-cut, a fall on a stone, the blow of a piece of slate, brick, shovel, &c. In almost all cases there is a fissure in the external table, but the internal table is said to have been fractured alone. Fractures with elevation of the fractured part can only be produced by direct wound, and are at once obvious.[1] The importance of the injury depends generally on the lesion of the brain or its membranes by the wound. The portion of bone turned up will be easily bent down again if it interferes with the union of the wound, or if it breaks in the attempt it may be removed.

Elevated fractures.

Fracture and other injuries by 'contre-coup.'

We frequently hear of fracture of the skull by 'contre-coup,' but it seems undeniable that, as Mr. Le Gros Clark has pointed out (op. cit. p. 102), this expression is generally employed in quite an erroneous sense. Strictly, it ought to mean that, the skull being struck at a given point, fracture occurs at the point diametrically opposite, while no force is applied to the skull in the latter situation. This appears to be quite unproved. If the vertex be struck, fracture often takes place at the base and not at the vertex; or if one side of the head be struck fracture often takes place at the other; but in the former case the injury to the base is due to the skull having been made to impinge forcibly on the occipital condyles; and in the latter, as far as I have been able to discover, it has always been the case that the opposite side of the skull has been driven against an obstacle; so that both are instances really of direct force. Again, when a blow is struck on one side of the vertex of the skull, the opposite side of the base of the brain is often lacerated, but this is obviously caused by the brain having been driven down on to the rough base of the skull. The term is, therefore, speaking accurately, quite incorrect, but it may be retained as having now come into general use to express the fact that a blow at one part of the skull often produces its main results at the other end of the axis of the cranium, a fact which is of considerable practical importance.

Diagnosis of fracture.

Excepting a few cases of comminuted fracture, in which crepitus is to be felt, or a fragment is movable,[2] the only diagnostic sign of a simple fracture of the skull is the depression by which it may be accompanied. If no such depression exists there is no means of knowing, in any case of concussion or other injury, whether the bone is or is not also broken. Nor does it much matter, for though, in popular language, a fracture of the skull is represented as a very grave injury—and rightly so, because fractures of the skull are usually accompanied by injury to the cranial contents—it should be remembered that it is this concomitant injury which alone gives them their gravity, and that in themselves fractures of the skull are hardly more serious than fractures of any other bone. The skull is richly supplied with blood, and simple fractures of the vertex, unaccompanied by any other lesion, unite very kindly.

In examining the skull for depression care must be taken not to confound the depression so often found in the centre of a lump of extravasated blood

[1] A good illustration of this rare form of fracture, also from St. George's Hospital Museum, will be found in Mr. Hewett's essay, p. 580.

[2] In a circular fracture of the vault and base of the skull described and figured by Mr. Hutchinson (op. cit. Pl. xxviii.) crepitus was thought to be detected during life.

with the depression of a fracture (see page 133). There are also some rare cases in which an injury has been received over a portion of the skull in which either the whole cranium or the external table only has been deficient from congenital malformation or from atrophy, and the edge of the deficient part has been mistaken for that of a fracture. The diagnosis of compound fracture is generally obvious; care must, however, be taken not to mistake a suture for a fissure; this may easily be done when the sutures are irregular, as in the instance of numerous Wormian bones.

The treatment of an undepressed fracture, whether simple or compound, consists merely in precautionary measures. In compound fracture everything should be done to promote the immediate union of the wound, and very often the fracture will heal as uninterruptedly as a simple fissure. The rest of the treatment consists merely in watching for and treating any cerebral symptoms which may arise.

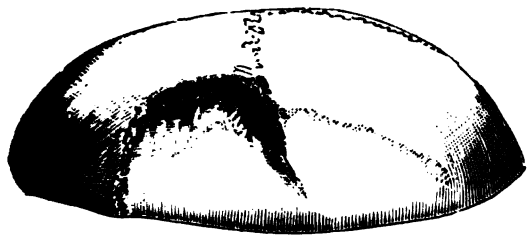


FIG. 43. An old depressed fracture of the skull soundly and perfectly cured without trephining. The fracture is seen to be chiefly of the frontal bone, extending slightly into the parietal. Its depth is equal to that of the whole thickness of the skull, and the length of the fissure is at least four inches. On the inside of the skull the angle of the depressed portion projects as a spike or thorn of bone which had penetrated the dura mater, and was lodged in a little pit or depression in the surface of the brain.
Nothing is known about the original injury, except that the man was in the Middlesex Hospital in the year 1853, fourteen years before his death, on account of some injury to his head; and that he had been subject ever since to violent paroxysmal attacks of pain in the head. The records of the Middlesex Hospital, however, contain no notice of the case.- Museum of St. George's Hospital, ser. i. No. 244 a.

Simple depressed fractures ought to be elevated by operation when accompanied by symptoms of compression or of irritation of the brain, but not otherwise, and in practice cases will often be met with where the surgeon will require all his acumen to determine whether the symptoms of cerebral irritation which exist do or do not depend on the depression of bone. When this depression, however, is considerable and there are cerebral symptoms, the operation is indicated.

In compound depressed fracture most surgeons are in favour of extending the province of operation so far as to say that they ought always to be elevated, whether symptoms are present at the moment or no. But this is a rule which is by no means universally adopted. Cases of depressed fracture, both simple and compound, often unite, and the patient recovers without operation. This is illustrated by the accompanying figure (43) and by some striking preparations of sabre-wounds of the skull in the Museum of the College of Surgeons. For my own part, if the depth of the depression is slight, and especially if its extent is also considerable, I have no doubt that in the absence of symptoms it is best left alone; whilst under opposite circumstances (i.e. the deep depression of a small piece of bone as shown in fig. 53) it might be better to elevate it; but then such a depression will almost certainly produce cerebral symptoms. And depressed compound fractures with symptoms should no doubt always be elevated. On the whole, therefore, the treatment of compound and simple fractures would not vary so much as used to be the rule. There is, no doubt, somewhat less hesitation in applying the trephine when the fracture is already exposed in a wound, but the depth and the extent of the depression are far more important considerations. The more a fracture approaches the 'punctured' form the more is trephining indicated.

Fractures of the base.

Fractures of the base of the skull are in the great majority of cases caused by indirect force, and are extensions downwards of fractures of the vault. Sometimes, however, they are caused by direct violence. This occurs most

Wounds of the orbit.

commonly in wounds of the orbit. Here it has frequently happened that a slight injury, such as the thrust of a foil or a parasol or some weapon, has inflicted an apparently trivial injury on or below the eyelid (generally the upper), and that the accident has been taken little notice of, until some days afterwards symptoms of cerebral inflammation have appeared and have proved rapidly fatal. On post-mortem examination the weapon has been found to have passed through the papery inner wall of the orbit into the brain, and a fragment has not unfrequently been found lodged in the cerebral substance. In other cases, though the brain has not been wounded, the cavernous sinus has been laid open, giving rise to fatal hæmorrhage, or to lesions of the orbital nerves, or to orbital aneurism.[1] All such cases, therefore, should be carefully examined at first, and sedulously watched afterwards. Other and rarer instances of direct fractures of the base of the skull are found, as, for example, in the preparation from St. George's Museum, figured in Mr. Hewett's essay, where the condyle of the lower jaw is driven through the base of the skull; but the vast majority are indirect fractures, sometimes of the form of simple fissures, at other times branching in various directions. They are either confined to a single zone or fossa of the base, or they implicate two or three fossæ at the same time.[2] The great majority of these fractures pass through the middle fossa. As stated above, the fracture usually extends into the vertex, being sometimes a branch of a fracture originating in the vault; sometimes,

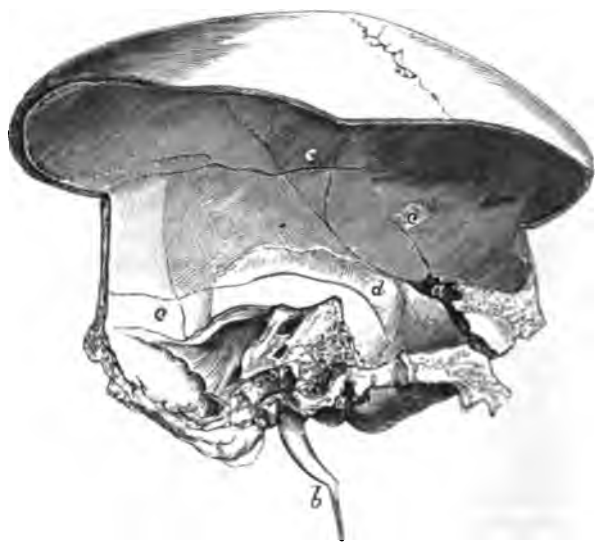


FIG. 44. A fracture of the skull in which some of the large branches of the middle meningeal artery were cut across, causing extravasation of blood between the bone and dura mater. A portion of the vault of the skull has been left on, in order to show that this fracture, contrary to what is usual in such cases, does not affect the vertex. It is of a trilateral shape, with a horizontal and two vertical branches, *c*, *c*, *c*. Some of the large grooves for the meningeal artery, *d*, are cut across, but not in the usual position. The main trunk of the middle meningeal artery was divided, and there was extensive extravasation of blood between the bone and dura mater, as well as laceration of the cerebral substance. Yet there was no paralysis as far as could be made out, though the patient was completely insensible and frequently convulsed. *a*, *a* refer to sections of the outer wall of the orbit, separated by the sphenomaxillary fissure; *b*, to the styloid process. St. George's Hospital Museum, Ser. i. No. 200.

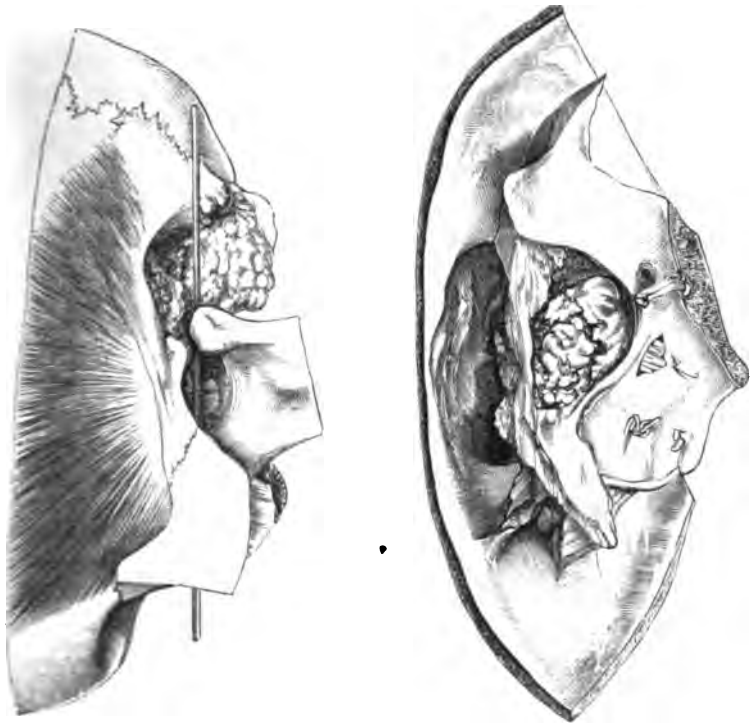
[1] See 'Lancet,' 1873, vol. ii. p. 143, for a reference to some of these cases.

[2] Mr. Hewett refers to the records of St. George's Hospital for ten years, comprising 64 cases of fracture of the base. Out of these there were 25 in which the line of fracture was confined to a single fossa; the anterior in 5 cases; the middle in 14; the posterior in 6. There were 29 cases where 2 fossæ were implicated, viz. the anterior and middle in 14; the middle and posterior in 15. In the remaining 10 the fracture traversed all 3 fossæ. Thus the middle fossa was implicated alone or with the others in 53 out of the 64 cases.—'Syst. of Surg.' 3rd ed. vol. i. p. 589.

but more rarely, it originates in a shock transmitted through the spine to the base of the skull, and spreading up into the vertex. In some cases, as in that which furnished figure 44, the fracture, though of considerable extent, may be confined to the base, but this is decidedly unusual in indirect injuries.

Symptoms of fracture of the base.

These fractures, occurring as they do in severe injuries of the head, are therefore usually accompanied by the ordinary cerebral symptoms. Irrespective of these the only symptoms of fracture of the base are the escape of the contents of the cranial cavity, or injury of the nerves which pass through the foramina at the base of the skull. Now, the contents of the cranial cavity are blood, subarachnoid fluid, and brain-matter. The brain-matter very rarely indeed exudes from a fracture of the base. I have seen, however, a case in which hernia cerebri took place into the meatus auditorius, and a preparation



A B

Fig. 43. A, the external and, B, internal, view of a preparation in which hernia cerebri took place into the external auditory meatus eight days after a gunshot wound. The case is related by Mr. Cæsar Hawkins, 'Contributions to Surgery and Pathology,' vol. i. p. 318.—St. George's Hospital Museum, Ser. viii. No. 13.

showing a hernia cerebri in the meatus is here figured. When present this symptom is of course decisive of the existence of fracture. But the usual symptoms are either extravasation of blood or escape of watery fluid.

In fractures of the anterior fossa the blood is extravasated at first in the deep cellular tissue of the orbit, and makes its way forward till it appears under the ocular conjunctiva and the lids.[1] This extravasation is distinguished from that of ordinary black-eye by its being less in the lids, considerable in the ocular conjunctiva, and increasing as it passes backwards out of sight.

[1] Fissured fracture of the roof of the orbit is met with frequently, according to Mr. Hutchinson (op. cit. Pl. xxix. fig. 3), in the post-mortem examination of cases in which there has been no symptom of this particular lesion.

The reverse is the case in a simple bruise. Blood may also pass through the body of the sphenoid bone into the nose, as it may also in fracture of the middle fossa. Persistent epistaxis, therefore, is sometimes met with in fractures of the base, or hæmatemesis occurs from the blood having been swallowed and rejected by the stomach.

The more common hæmorrhage, however, in fractures of the middle fossa is from the ear, the membrana tympani being usually lacerated in such injuries, whereby a way is afforded for the blood to pass out from the lateral sinus, or any other large vessel in its neighbourhood which may have been wounded in the fracture. Bleeding from the ears is accordingly a valuable sign of fracture of the middle fossa of the base of the skull, when copious and long-continued; though it cannot be said to be absolutely diagnostic of the injury, since considerable bleeding has been known to occur in injuries involving only the ear itself. Blood may also pass into the pharynx and nose, causing hæmatemesis and epistaxis, which, however, may have so many other sources that they can only very rarely assist much in the diagnosis. In some rare cases extravasation of blood behind the wall of the pharynx is found.

In fractures of the posterior fossa blood may be extravasated in the neighbourhood of the mastoid process, in the occipital region, or at the side of the neck, and such extravasation may become a valuable sign of fracture in cases where the soft parts are known not to have been bruised. Tenderness to pressure over the mastoid process is sometimes observed in such cases.

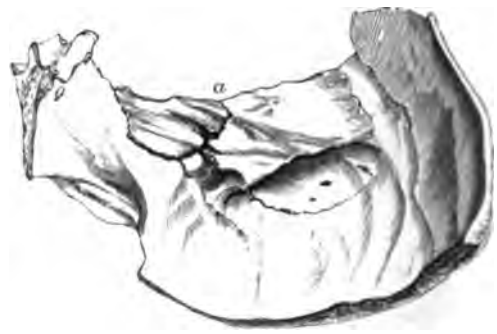


FIG. 46. Part of the base of the skull, showing a line of fracture which traverses the internal auditory meatus. The principal fracture formed the upper boundary of the piece of skull here depicted. At the point *a* a branch ran down through the internal auditory meatus into the jugular foramen. The patient had fallen downstairs, striking one side of his head. He was admitted in a state of partial insensibility, bleeding from the opposite ear and from the nose. Next day a copious watery discharge commenced from the ear and continued till his death, which took place three days after the accident, from suppurative inflammation of the cerebral membranes. Small extravasations of blood were found in the anterior pillars of the fornix, and on the under surfaces of both middle lobes of the brain.—St. George's Hospital Museum, Ser. i. No. 243.

Serous discharge in fracture of the base.

But the most striking symptom of fracture of the base of the skull, and one which under certain circumstances is really decisive of the nature of the injury, is the discharge of serous fluid. This occurs, though very rarely, also in fractures of the vertex,[1] and it has been known to take place through the nose, but in all ordinary cases the discharge is from the ears. When, immediately after the injury, a copious discharge of watery saline fluid —i.e. fluid containing only the faintest trace of albumen[2]—is found issuing from the ear, there can be no question that there is a fracture of the base of the

[1] Mr. Lucas, in 'Guy's Hospital Reports' 1876, has an interesting account of a case of fracture of the skull in a child followed by a collection of cerebrospinal fluid in the scalp, and in a subsequent paper in the same series for 1878, he relates the post-mortem examination of this child; and again, in a further paper, in the volume for 1881 he pursues the subject and gives other cases, and in a review of the whole matter argues (1) that large collections of cerebrospinal fluid beneath the scalp, after fracture of the vertex, only occur in children; (2) that when cerebrospinal fluid escapes from the vertex, in quantity, the ventricular cavity has been laid open.

[2] 'The absence, except in small quantity, of albumen, and the presence of an excess of chloride of sodium in the cerebrospinal fluid, has been repeatedly shown by analysis.'— Le Gros Clark.

skull cutting the meatus auditorius internus across, and thus laying open that prolongation of the arachnoid membrane which accompanies the seventh pair of nerves down the meatus, whereby the subarachnoid space is laid open. For no other cavity, except perhaps the ventricular, exists in which there is any collection of such fluid.[1] But when after an injury to the head, followed by bleeding from the ear which has lasted more than a day, a watery (or rather colourless) discharge follows, which contains more or less of inflammatory products, the inference is not so clear, for such discharges may be furnished by the lining membrane of the external meatus only, or by that of the tym-



FIG. 47. Fracture of the anterior fossa of the skull, united. The patient died of erysipelas two months after the injury. The fracture traversed the anterior and middle fosse of the skull. At *a* is seen the line of the fracture traversing the anterior fossa. The union here is very perfect. In other parts a considerable deposit of vascular porous new bone is found around and between the edges of the fracture. *b* shows a mass of partly decolourised blood-clot, mixed with organised fibrine on the outer surface of the dura mater, corresponding to the fracture.—From the Museum of St. George's Hospital, Ser. i. No. 34.



FIG. 48. Union of an old fracture of the posterior fossa of the base of the skull. The accident had occurred three years before death. On post-mortem examination the line of fracture was found to commence at the upper part of the occipital bone, and its upper half has been completely united, and is seen on the outside of the skull as a mere groove in the solid bone. On the inner surface the bone was found thickened and vascular at this part, from deposit on its internal surface. The lower half of the line of fracture is not united, but a distinct fissure is left which (as seen in the engraving) is perfectly open in the macerated bone, the margins being thinned and rounded off by absorption. In the recent state this fissure was completely filled by fibrous tissue. Complete bony ankylosis had taken place in the joint between the atlas and occiput, and the lateral sinus was obliterated at its termination ('Path. Soc. Trans.' vol. vii. p. 282).—St. George's Hospital Museum, Ser. i. No. 36.

panum, and have been known to occur in cases in which it has been proved by dissection that there was no fracture of the skull whatever.[2] Such dis-

[1] There seems some possibility that the descending horn of the lateral ventricle may in some cases have been broken into; and cases which support this belief may be found quoted in Mr. Hewett's essay, p. 597. Dr. Moxon believes that the fourth ventricle is sometimes injured. (Wilks and Moxon, 'Path. Anat.' 2nd ed. p. 38.) In Mr. Lucas's case, the child died two years after the injury, in consequence of acute inflammation of the membranes. The post-mortem examination showed that the cerebrum had been lacerated into the lateral ventricle, and that the swelling under the scalp was formed by the dilated ventricle.

[2] See in the 'Path. Soc. Trans.' vol. vi. p. 22, a case reported by Mr. Gray, in which

charges, however, are far less watery than those which consist of the cerebro-spinal fluid, and they can never occur *immediately* after the injury, though they may commence after a short interval.

Lesions of the nerves which issue from the base of the brain are tolerably often present in fractures of the base; and the paralysis of the nerves, especially those of the seventh pair, is a symptom strongly confirmatory of the diagnosis, though, as will be seen in the sequel, paralysis of these nerves may also result from ecchymosis into their substance, and probably from inflammation following an injury of any kind; so that the symptom is not in itself unequivocal.

Union of fractures of the base.

Fracture of the base of the skull is by no means necessarily fatal.[1] Excluding very many cases in which all the symptoms have existed, but the patient has recovered, so that the diagnosis has not been absolutely certain, we have ample anatomical proof that such fractures do get well,[2] and that they are not insusceptible of union, though in the parts of the base where the bone is very thin and the foramina large the union is apt to be irregular, and the edges may often be found somewhat absorbed, forming a chink or fissure. Figs. 47–49 furnish illustrations of united fracture in each of the fossæ of the skull from the Museum of St. George's Hospital.

No treatment is required for the fracture of the base beyond that which the concomitant injury of the brain demands.



FIG. 49. Fracture of the left temporal bone, extending into the base of the skull. The patient died two months afterwards, from a different cause. The part of the bone here represented is the squamous portion. 'The edges of the fissure have been so thinned away by absorption that an opening in the bone is formed, 1½ in. in length, tapering to its extremities, and ¼ in. in breadth at its centre. At the points where the edges of the fissures are in contact (between *a* and *b*) no bony union has taken place, as ascertained by Mr. Tomes on endeavouring to make a section for the microscope.' See Mr. Gregory Forbes in 'Lancet,' vol. i. p. 580, 1849.

Lesions of the brain.

V. We must now pass on to those symptoms which accompany injuries of the brain itself.

These are usually classed under two heads—Concussion and Compression of the brain. Such a classification, however, is far from complete; for many cases are met with in practice which it is very difficult to include under the term Concussion, and yet which do not exhibit any decisive evidence of

serous discharge followed upon injury to the tympanum, and inflammation of the lining membrane of the tympanum and mastoid cells, but without any fracture of the temporal bone. And in the same series (vol. xii. p. 159) a case by myself, where serous discharge was produced by a fracture of the neck of the condyle of the lower jaw perforating the meatus, but without any injury to the skull whatever.

[1] Dr. Lidell has recorded, in the 'Am. Jour. Med. Sc.' April, 1881, 135 cases of fracture of the base of the skull from gunshot, followed by more or less perfect recovery, all of which occurred in the American War of Secession.

[2] Mr. Hilton has pointed out the fact that in the middle of the basis cranii the brain by no means accurately fits to the bone, but, on the contrary, is separated from it by a considerable collection of cerebrospinal fluid; and he gives some interesting cases in which fracture of the base of the skull was proved to have taken place, but where at first there were no cerebral symptoms.—'Lectures on Rest and Pain,' edited by Jacobson, pp. 22–26.

compression. The only way to include all cases under these two heads is to regard all those as instances of concussion in which there is insensibility after injury (to a greater or less extent), unaccompanied by paralysis ; and all those in which there is paralysis, as cases of compression. But such a definition departs very far from the original meaning of the term Concussion. In fact, when this term was introduced it was believed that in cases where insensibility follows injury, without paralysis, the brain was often free from any visible lesion—very much in the condition of a jelly when shaken up—and that, if examined, no laceration of its substance or its vessels would be found. This opinion was supported by some histories of patients who had died immediately after blows on the head, whose death was attributed to concussion, and in whom the brain was found free from any trace of injury, as in the case recorded by Littre[1] of a prisoner whose arms were bound behind him, and who rushed with his head against the wall of his cell, falling dead on the floor. The brain alone was examined, and no trace of injury found in it ; and this case was put down as one of concussion without visible lesion of the brain. But, in this as in other cases of supposed death from concussion, the upper part of the spine was never examined, nor the viscera ; and Mr. Hewett has pointed out that without such examination the fact that death was really caused by concussion is quite unproved ; in fact, it is most probable that, in the case mentioned above, the man died from injury to the upper part of the spinal cord. Mr. Hewett gives a remarkable case where the death was attributed to concussion ; the head was alone examined, and the case would have been recorded as one analogous to Littre's, had it not occurred afterwards to another surgeon to reopen the examination and investigate the condition of the medulla oblongata and spinal cord, when death was found to be due to injury of the upper part of the spine. In other cases death may have been caused by rupture of the heart or some of the great viscera. There is, therefore, at present no evidence that any case of concussion ever occurs without anatomical lesion of the brain or its vessels to some extent. We may nevertheless concede that, as Mr. Savory argues,[2] even if it be true that no case of concussion occurs without some lesion, yet this does not prove absolutely that such lesion is the cause of the insensibility, since that insensibility will pass away suddenly, while the lesion must, of course, still be present ; and, besides, such lesions have been known to be present without any symptoms of concussion. Therefore, though it is not proved that concussion occurs without anatomical lesion, it is certainly not disproved—nay, there is *à priori* reason for thinking that it may do so.[3]

[1] 'Mém. de l'Acad. des Sc.' 1705, p. 54.

[2] 'St. Barth. Hosp. Reports,' vol. v. p. 72.

[3] A case published in Mr. Hutchinson's 'Illustrations of Clinical Surgery,' p. 80, goes far to prove that even fatal concussion may occur without discoverable lesion. In this case the patient was a child æt. 5, and died 60 hours after the accident, in which she had been run over, the wheel apparently passing over the chest ; but the symptoms were mainly those of concussion, and no lesions were found in the lungs, heart, or spinal cord ; nor was anything found in the brain, beyond general congestion. The same great authority expresses (ibid. p. 84) an opinion identical with that in the text :—'A considerable number of the head cases fatal within periods of a few hours or a day or two die from the general effects of the shake of the cerebral mass. Lesions are found, it is true ; but they are to be regarded as indications of the violence of the shake, and not as causes of death, nor perhaps even as serious complications.' Mr. Hutchinson regards anæmia of the brain as being the proximate cause of the phenomena of concussion. Mons. Duret (referred to in 'Brit. Med. Jour.' Dec. 29, 1877) refers them to a change in the tension of the cerebrospinal fluid. But the question is certainly as yet unsettled.

It would be far more satisfactory, and more in accordance with the practice of surgical literature in its other departments, if we could classify the injuries of the brain, not according to their symptoms, as Concussion, Compression, &c., but according to the anatomical lesion, as cases of extravasation in the membranes or in the substance of the brain, of contusion, and of laceration of the cerebral substance. But our knowledge of the symptoms which depend on each of these injuries is so very imperfect that this anatomical division is as yet impossible. No distinct symptoms exist from which it can be affirmed that in one case there is extravasation of blood in the cavity of the arachnoid; in another, punctiform extravasation in the substance of the brain; in another, laceration of the surface; in another, of the central parts of the encephalon; and still less can we localise the lesion which we may suspect. All that can be said as yet is, that in cases of slight concussion small extravasations probably exist either on the surface of the brain or scattered about in its substance, or the brain is bruised here and there, and that in all cases where the symptoms of head-injury are very severe (as where there is severe spasm or profound coma, with general paralysis) the brain will be found lacerated. I exclude, of course, cases of external pressure in which the compressing agent and the part compressed can be diagnosed with more or less approach to certainty.

Concussion of the brain.

The symptoms of concussion are as follows:—The patient is stunned, and lies insensible, with pale face and cold skin; the pulse is weak, possibly imperceptible, and often very irregular; the state of the pupils is variable, but usually they respond to light; the breathing is feeble and shallow; the urine and fæces may be passed involuntarily, but there is no paralysis of the sphincters nor any other symptoms of paralysis.

This is the first stage, that of insensibility or collapse.

Temperature in injuries of the head.

I append a thermograph of an ordinary case of severe concussion which passed over in about the average time, and have also noted the rate of the pulse and respiration. (Fig. 51.)



Fig. 50. Depression of the brain, from a case in which the patient had suffered from severe concussion twenty years before his death.

The case is related in Mr. Hewett's essay, 'Syst. of Surg.' vol. i. p. 609, from which the woodcut is taken.

In this case the mechanical lesion which accompanied the symptoms of concussion must have been superficial laceration of the brain, followed by extravasation of blood into the lacerated part. In other cases punctiform extravasations have been found in various parts of the brain, and probably the extravasations of blood in the membranes of the brain uncomplicated with laceration or bruising of its substance, which are spoken of on p. 140, are sometimes accompanied by symptoms of concussion.

On the subject of temperature in head-injuries I cannot do better than again quote from Mr. Le Gros Clark's valuable lectures:—'The temperature in cases of severe head-injury seems to be no measure of the amount



Fig. 51. Thermograph of Concussion.

of lesion sustained by the brain. Thus, in two instances of simple concussion, in which the temperature was taken half an hour and an hour respectively after the accident, it was found to be 98·5° and 96·2°: yet both these patients recovered without any reaction beyond the normal standard. In another case of hæmorrhage into the brain, with total unconsciousness, the temperature

was noted as being 95·2° half an hour after the injury, and never sank below 94·9°. In another remarkable instance, however, of fractured base, with laceration of brain, the temperature fell as low as 87·4° in an hour and a half after the accident. I am not aware of any lower recorded temperature. This patient survived about nine hours, but the temperature scarcely attained 90° just before death' (op. cit. pp. 122, 123).

The second stage is that of reaction. The patient can now be roused, though sometimes not without difficulty. He usually vomits. The pulse rises and becomes more regular, and the natural temperature returns; headache generally is complained of for some time, and drowsiness is a very common symptom.[1] After this the patient may entirely recover, or the third stage may ensue, which is that of traumatic inflammation of the brain or its membranes—to be afterwards described.

Treatment.

No treatment is necessary in the early stage of concussion. If the collapse is very alarming it may be thought right to give some stimulant, but this is hardly ever necessary in cases of average severity. Warmth and sinapisms may be applied to the extremities and epigastrium. When reaction sets in it should be watched. If moderate, nothing will be required beyond quiet, cold to the head, and low diet, with occasional purgatives. If the pulse rises very rapidly in volume and rate it is right to take blood from the arm. But the question of venæsection and of the administration of mercury rather belongs to the treatment of traumatic inflammation, which will be considered further on.

It must be remembered that the tendency to death in pure concussion is from syncope or shock—failure of the heart's action; so that the only treatment which can be efficacious in the early stage is such an administration of stimulants as in the judgment of the surgeon will not involve the risk of provoking inflammation.

I would repeat that in this, as in all other forms of injury to the head, perfect quiet, in a darkened chamber, seems of great importance as a precaution against too severe reaction; and with regard to the importance of prolonged rest from mental and physical exertion, after all severe injuries of the head, I would refer to Mr. Hilton's admirable 'Lectures on Rest and Pain' (ed. 1877, p. 46 et sqq.).

Compression.

Compression of the brain is the term used to describe cases in which there is definite evidence of paralysis—a condition marked by stertorous, oppressed, and slow breathing; dilatation of the pupils, perhaps with insensibility to light; slow, laboured pulse; relaxation of the sphincters; coma; and paralysis of the limbs on one or both sides.

Compression seems to me to depend generally on the extravasation of blood into the interior of the brain from laceration. It usually proves rapidly fatal when that laceration involves the central parts, giving rise to rapid extravasation into the ventricles, the pons Varolii, or the medulla oblongata; and such cases are quite beyond the reach of surgical treatment. It is only when the paralysis affects one side (that opposite to the injury), and appears to be due to one of the well-known causes—viz. depression of a fracture, lodgment of a foreign body on the surface of the brain, extravasation of blood between the bone and dura mater, or superficial effusion of pus—that the operation of trephining is justifiable. In such circumstances I think it is so, though in none of them is it often successful. The paralysis which

Trephining in compression.

[1] I would refer the reader to the tabular statement of the usual symptoms of concussion given by Mr. Hutchinson on p. 86 of his 'Illustrations of Clinical Surgery.'

accompanies depressed fracture or the lodgment of a foreign body often depends really on extravasation of blood within the brain from laceration, or on inflammation of the membranes.[1] Extravasation of blood above the dura mater very rarely is limited to the precise point which can be reached by the trephine, and it also is often accompanied by central or by meningeal extravasation. And the numerous causes of failure in trephining for pus have already been fully detailed. Therefore, though in desperate cases any operation is justifiable which holds out a reasonable hope of success, it is not to be wondered at that trephining is very rarely successful, or that some surgeons appear to have almost altogether renounced it.

These views about the justifiability and the causes of failure of trephining may be illustrated by figs. 52 and 53, taken from two cases of depressed fracture, in one of which trephining was performed, and in the other not. In fig. 52, although the operation seems to have been performed most thoroughly and most successfully, as far as the elevation of the depressed bone goes, it proved useless in consequence of the subjacent mischief. And I may take occasion to remark that in many instances the immediate object of the operation—viz. the replacement of the depressed bone—is not effected by any means so fully as in the case before us. The examination of a large number of Museum specimens has shown me that often, although the greater part of the bone has been lifted up, and the operation must have appeared to the surgeon to have been completed (and no blame can attach to him for thinking so, and for abstaining on that account from any further interference), yet examination from the inside would show spicula or depressed edges still irritating the membranes or the brain.

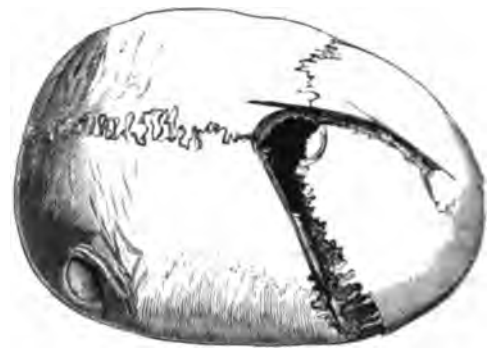


FIG. 52. An extensive depressed fracture of the vertex of the skull which has been elevated by trephining. The mark of the trephine is seen at the corner of the sound bone, and it has also just touched the end of the depressed bone; and the traces of Hey's saw, which has been used to take off the overhanging edges of the sound bone, are very distinctly marked. The depressed bone has all been very fairly elevated, and the operation did temporarily relieve the symptoms of compression, as the patient became a little more sensible and was able to speak; but he only lived a few hours. Death was caused mainly, as it seems, by hæmorrhage between the bone and dura mater, the source of which was not precisely ascertained. The fracture passed across one of the main grooves for the middle meningeal artery, but the vessel itself appeared uninjured. The dura mater was not torn, but the lower part of the middle lobe of the brain was contused on each side. The depression seen at the back of this preparation appears to be due to some old injury; but nothing is known about it.—St. George's Hospital Museum, Ser. i. No. 16.

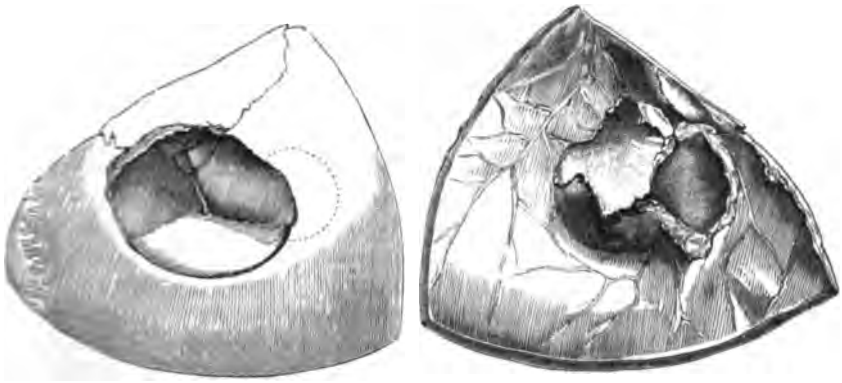
In fig. 53 is seen one of the ordinary injuries in which the practice of different surgeons varies. There was no positive compression; the brain was deeply injured, and the surgeon thought it useless to interfere. Yet it is perfectly fair to argue that in a case where it would have been so easy to remove sharp edges of bone sticking into the wound of the membranes and irritating the lacerated surface of the brain, it ought to have been done, as affording a patient the last chance, however feeble it might be: and such is unquestion-

[1] Mr. Hutchinson says ('Illustr. of Clin. Surg.' i. 67) that he never witnessed a death produced by compression from depressed bone. There is also in his table of the causes of death in 46 fatal head-injuries only one of compression by extravasated blood.

ably my own opinion.[1] The fracture is a less-marked example of the form which Mr. Hutchinson figures on Pl. XXXII. under the name of 'pond depression,' and regards as extremely appropriate for trephining.

Cases not classifiable under the above heads. Laceration or contusion of the brain.

Besides the cases which correspond to the typical descriptions of concussion and compression, cases are met with (and not rarely) in which the insensibility is by no means complete, and where it is difficult to see whether there is not some imperfect paralysis, but where other symptoms are far more prominent. In some of these cases there is delirium—sometimes quiet, sometimes furious and maniacal—spasms or convulsions, constant screaming, excessive irregularity of the pulse, and in many cases great irritability when roused. Such symptoms may be connected with laceration of various parts of the brain in which the hæmorrhage has not been sufficient to produce complete compression; but it must be admitted that we know little of the real anatomy of them beyond this, that in those cases which prove fatal (for many recover) some laceration of the brain, or extravasation into the membranes, appears to



A, OUTER VIEW. B, INNER VIEW.

Fig. 53. Compound depressed fracture of the parietal bone. The brain in this case was lacerated, and the escape of brain-matter from the wound relieved the symptoms of compression, so that the patient (a boy æt. 16) was sufficiently sensible to give an account of the accident. He had no head-symptoms for three days. Then pain in the head came on, with suppuration and increased discharge of brain-matter from the wound. A fortnight after the accident he became suddenly unconscious, with stertor and dilated pupils. Next day he died. At the post-mortem examination a large abscess was found, occupying all the outer part of the middle lobe on that side. The injury was caused by a fall through a skylight. The drawing shows the exact limitation of the fracture, and the ease with which the whole of the depressed bone might have been removed. Fig. A presents the external aspect. At one angle is dotted the circle of an imaginary trephine hole. If this portion of bone had been removed, the whole fracture might have been elevated at once, for the large fragment at the opposite side of the fracture was perfectly loose (and has fallen out in the preparation), and by lifting up the upper of the two other fragments which were interlocked they might both have been most easily removed. Thus all the rough, jagged edges, which are seen in fig. B sticking into the brain, would have been taken away.—St. George's Hospital Museum, Ser. i. No. 248.

have been always found. But as such laceration and extravasation have existed in cases presenting no such symptoms, it is clear that the real cause of the difference in different cases between the sequelæ of injuries which seem nearly identical in their anatomy is still to seek. Mr. Hutchinson teaches that one of the most constant effects of compression is to cause anæmia of the brain, and that such anæmia may be a cause of convulsions.

In all such cases it seems to be the chief object of treatment to avoid and soothe excitement, for which purpose strict quiet, in a darkened room, is most essential. The head should be shaved, and cold lotion or an ice-bag applied, if the patient is not too restless; otherwise it should be constantly wetted, so as to cool it by evaporation. Low diet should be insisted on, unless contraindicated by the state of the pulse; and the cautious but, if necessary, free use

[1] Mr. Hutchinson teaches the same doctrine.—See his Pl. XXIX. and the commentary.

of morphia has in some striking cases appeared to me to be of the most signal service in calming the spasms or fits, and so saving the patient from death by exhaustion.

Traumatic inflammation.

Compression tends to death by coma, i.e. by gradually increasing insensibility and paralysis, which, when it extends to the functions of deglutition and respiration, necessarily proves fatal. And such paralysis is due to one or both of two causes, viz. pressure by extravasated blood or pus or by foreign bodies, or softening from inflammation of the substance of the brain. Such inflammation is the most formidable accident in head-injuries, and the chief object of our treatment is to obviate or to combat it. In old times bleeding was used unsparingly with this view—no doubt too indiscriminately; but I have met with no hospital surgeon who does not think that the reaction against this 'antiphlogistic' treatment has also been too indiscriminate, and who could not recall striking instances of the benefit of judicious venæsection in cases of apprehended or incipient inflammation after injury to the brain. The great point is to be aware of the symptoms which mark the onset of this inflammation, so as not, on the one hand, to depress the patient, and possibly favour the occurrence of diffuse suppuration by injudicious and unnecessary loss of blood, or on the other, to allow the inflammation to get ahead, when bleeding will probably prove useless.

Traumatic inflammation affects either the membranes (meningitis) or the substance of the brain (encephalitis). The membranes may be involved in injury of the bone, the inflammation spreading from the dura mater inwards, leading to effusion in the arachnoid cavity, where it is almost always diffused, and to inflammatory cellulitis of the pia mater; or the inflammation may spread outwards from the injured brain, and then it is often limited to the pia mater. Traumatic encephalitis may be caused by the spread of meningitis inwards, or it may be the result of lesion of the substance of the brain, and so follow on a case which has commenced as one of 'simple concussion.' Its common results are, softening, usually of the surface, sometimes also of the central parts of the brain, effusion into the ventricles, or abscess of the brain.

The symptoms of meningitis and encephalitis have not been found as yet to admit of diagnosis from each other beyond such a conjectural opinion as is derived from the exciting cause. The early symptoms are—pain in the head, feverishness, hot skin, quick pulse, contraction of the pupils, intolerance of light and sound. Then sickness ensues, with restlessness.[1] Convulsions succeed—at least this is the usual order of appearance of this symptom, though there are cases in which they come on very early, and are almost the first alarming symptom noticed. They are followed, or sometimes preceded, by delirium. Coma ensues, and then paralysis. The first onset of inflammation may be heralded by rigors; but rigors occur usually in the later stage of inflammation, and may be taken as indicative of suppuration.

Whenever traumatic meningitis or encephalitis is diagnosed, or even when there is reasonable cause for apprehending such an event, the first indication is certainly to shave the head, and apply cold to it, to purge the patient very freely by a large dose of calomel, followed by a saline purgative, and to keep him very quiet in a darkened room. If the pulse rises decidedly in rate, and if its volume and hardness also increase, I never saw a case in which any

[1] Mr. Hutchinson has recorded a case of inflammation of the subarachnoid tissue at the base of the brain in which sleeplessness was a prominent symptom. Op. cit. p. 75.

harm resulted from a moderate bleeding (say 10 to 12 ozs.) and many in which it did great good. At the same time mercury should be given in powder, calomel being the salt usually selected, in doses of about 2 grs. four or six times a day. The powder can be placed on the back of the patient's tongue with a little sugar, if he is unable or unwilling to swallow. When there is much excitement, and especially if convulsions are present and are severe, morphia is very beneficial, either combined with the calomel or introduced under the skin, or both. We have the high authority of Mr. Hewett for saying that 'opium or, better still, morphia is doubtless of great value in many cases presenting some of the most characteristic symptoms of inflammation.'[1]

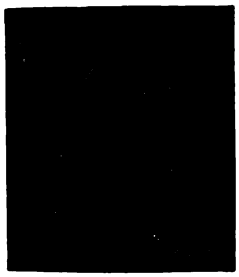


Fig. 54. A thermograph showing the rapid rise of temperature which sometimes is noted in cases of head-injury as inflammation comes on and passes into suppuration. The patient was admitted with compound fracture of the frontal sinus, involving also the internal table, a portion of which was driven into the brain. The depressed bone was perfectly loose, and was easily removed from the brain; but inflammation and suppuration of the injured anterior lobe rapidly supervened.

The main questions in the subsequent treatment are whether to repeat the venæsection, and whether the trephine is indicated. The first is a matter which will tax the surgeon's judgment and tact. There can be no doubt that many cases have terminated unfavourably from overbleeding, of which Mr. Hewett records a remarkable example, where, however, the diagnosis was also at fault, for, after death, no anatomical proof of inflammation was found. But this ought not to discourage the surgeon when the indications are clear, i.e. if the same symptoms which first led him to bleed, still continue, or even increase. A very valuable contra-indication to repeated venæsection is pointed out by Mr. Hewett in the watery condition of the blood, which sometimes is noticed after one or two bleedings. In cases where the indications of cerebral congestion and excitement persist (heat of head, excessive pulsation of carotids and temporals, violent delirium), but the general circulation hardly warrants bleeding, leeches may be applied to the scalp and temples. As to the indications of the formation of pus beneath the cranium, and the symptoms which justify trephining, reference must be made to p. 137.

Hernia cerebri.

Hernia cerebri is a consequence of local or limited inflammation of a portion of the brain, co-existing with wound or sloughing of exposed dura mater, whereby the inflamed brain is forced through the skull. It is not every wound of the brain, even when it involves loss of substance, which necessarily produces hernia cerebri. I have seen a portion of the brain sliced off (in a case of encephalocele mistaken for encysted tumour), and no harm result. And there are plenty of instances on record in which large portions of the brain have been torn away in injuries of the head, and the wound has healed kindly. But very commonly after a compound fracture, in which the dura mater has also been lacerated, in a few days an offensive ichorous discharge is noticed from the wound, and a fungous mass begins to sprout out of it. This sloughs and drops off in fragments, which, if examined in the microscope, are found to consist in great part of the products of inflammation. Sometimes, indeed, they consist entirely of such products, and to these protrusions the name of 'false hernia cerebri' is sometimes given, reserving the name of 'true' for those in which the characteristic structure of the cerebral substance can be found.

[1] Op. cit. p. 625.

Hernia cerebri is generally fatal, though by no means universally so. It commonly occurs in compound fracture of the vertex; but I have figured above an instance in which it took place in the middle fossa of the base of the skull; and Mr. Holden has referred to a remarkable instance in the anterior fossa, where the patient, a boy, lost a large quantity of brain-matter through the nose, but ultimately recovered. I once watched a case in which the greater part of one anterior lobe of the cerebrum was discharged through a compound fracture of the orbit, in which the whole roof of the orbit had been removed. There were remarkably few symptoms, and the boy seemed to have a fair chance of recovery, when symptoms of general pyæmia developed themselves, and he died eighteen days after the injury. It is often remarkable how little the functions of the brain suffer even when, as in this case, the actual loss of substance is great. Often, however, the real loss is but small, since a great proportion of the fungus consists of inflammatory products.

No treatment is either necessary or indeed admissible in hernia cerebri, beyond such applications as may correct the fœtor of the discharge as far as possible. All attempts to repress the protrusion are dangerous, and probably inefficient, and the practice of shaving it off is quite exploded.

Injuries of the cranial nerves.

I can say but little on the subject of direct lesion of the nerves at the base of the brain. Those of the seventh pair are the most common, and in fractures of the base loss of hearing and facial paralysis are not unfrequently noticed. Extravasation of blood in the sheath of the optic nerve has been found after death, and blindness may be so caused, and may pass away, though in other cases it has resulted from absolute laceration of the nerve, and is then probably permanent. But all the nerves of the base (with the exception, I believe, of the little fourth nerve) have presented distinct evidence of traumatic lesion, as indicated by the loss of their function, and proved by

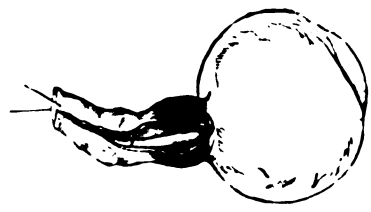


Fig. 55. Extravasation of blood in the sheath of the optic nerve after injury to the head. From Mr. Hewett's essay, 'Syst. of Surg.' 3rd ed. vol. i. p. 615.

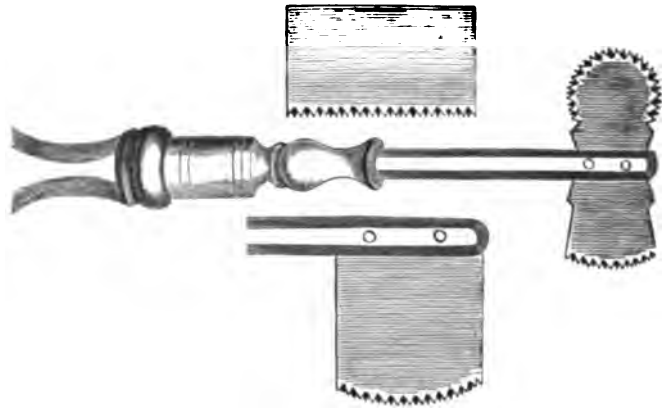


Fig. 56. Hey's Saw (from Hey's 'Surgery').

post-mortem examination. No treatment can be adopted; but the symptom is often valuable in a diagnostic point of view. It is important to remember the fact on which Mr. Le Gros Clark has laid some stress, that the symptoms

of paralysis, indicating lesion of the nerves at the base of the skull, often do not present themselves till three or four days after the receipt of the injury, showing that they are due to inflammatory reaction. This fact, however, by no means negatives the diagnosis of fracture, since a fracture is one of the most probable causes of such inflammation.

Trephining the skull.

The operation of trephining the skull, although it is always called by that name, is not always performed with the circular saw called the trephine. The elevated edge of an injured bone is often more easily and expeditiously removed by the saw which bears Hey's name.[1] The straight edge enables the surgeon to remove any length of bone at one stroke. When a curvilinear direction has to be given to the section the round edge must be used.



Fig. 87. The 'Elevator.' *Mem.* In trephining it is well to have a few elevators of different shapes and curves at hand. The one here represented is, however, one of the most useful.

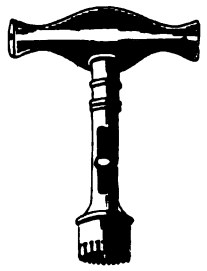
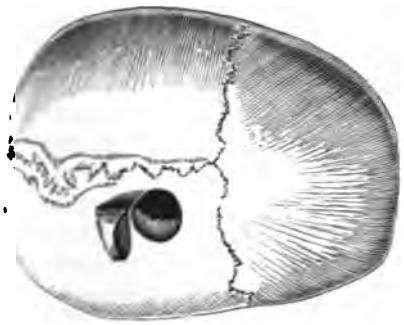


Fig. 88. Trephine. The central pin is seen projecting slightly beyond the teeth of the saw. It can be withdrawn altogether within the crown of the instrument by the screw which is seen in the cleft of the stalk.

Trephining is an operation which is neither very easy in all cases nor destitute of dangers of its own in any. The soft parts are first to be cleaned carefully from the part of the bone on which the trephine is to be applied, which in cases of fracture should be the sound bone on the edge of the depressed portion, and, if there are two depressed and interlocking pieces, the trephine-hole should hit the edge between them (see fig. 53). It is well to avoid the known situation of a large sinus if possible, though in cases of depressed fracture it may be necessary to apply the trephine directly over a sinus (see fig. 52). The pin of the trephine, being run out and firmly fixed, is applied at such a point as will secure this object, and then by a screwing motion the section of the bone is commenced. When the groove is deep enough to avoid all risk of the trephine slipping, its pin is withdrawn, and as soon as the surgeon believes that he has got through the external table[2] he begins to proceed with caution, and with a very light hand, often feeling the groove with a fine probe, or, as is more usual, a common quill toothpick. When the internal table is perforated at any part of the circle the elevator is introduced here, and the crown of bone will generally come away. If it does



89. The vertex of the skull, with a portion of bone removed in trephining for supposed depression of the outer table, ten months after the injury. The skull has been much thickened, especially at its back part, by inflammation, so that the thickness of the bone removed is twice as great behind as in front. In consequence of this irregularity in thickness the dura mater was wounded in the operation.—St. George's Hospital Museum, Ser. ii. No. 24.

[1] This saw, as Mr. Hey points out, was originally figured in Scultetus's 'Armamentarium Chirurgicum,' and was either revived or re-invented by Dr. Corbell of Pontefract, who showed it to Mr. Hey.

[2] Sometimes the removal of a crown of trephine from the external table only will allow the surgeon access to the depressed bone so as to remove it—a fact of which Mr. Hutchinson gives two examples (op. cit. Pl. XXXI. figs. 1 and 3).

not do so, the internal table must be sawn in some other part; but the trephine must not be pressed on the part already sawn through, for fear of wounding the dura mater. When the first crown of trephine has been removed it may be necessary to take away a second or a third, or to saw off the projecting edges of the sound bone with Hey's saw (as in fig. 52); or perhaps the whole operation may be accomplished with the saw, in using which the same precautions are to be taken as in sawing with the trephine: but there is less risk of wounding the dura mater with Hey's saw, since it is only applied on the sound edge close to the fracture, and here the dura mater has of course been driven down by the depression. The greatest danger to the dura mater is in cases like the one from which figure 59 was taken, where the skull is of different thicknesses at different parts of the circle.

As will be seen from the foregoing pages, trephining is indicated—1, in cases of compression produced by depressed fracture or lodged foreign bodies; 2, in certain cases of irritation or symptoms of pressure supervening in depressed fracture; 3, in cases of localised pressure from extravasated blood; 4, in cases of intracranial suppuration where the symptoms are those of localised pressure.

CHAPTER VIII.

INJURIES OF THE BACK.

Sprains of the back are amongst the commonest of all accidents. They are the effect of wrenches or contusions, either of which produce violent flexion of the whole column, and which, therefore, sprain it at the part where such flexion is arrested, viz. near the sacrum. Sprains of the back.

The injury consists in stretching, and in the severer cases probably more or less rupture, of the muscles, fasciæ, and ligaments on the posterior aspect of the spine, while the parts in front may be more or less crushed; and in particular, the kidney is sometimes contused or lacerated. The latter injury will, however, be treated of by itself in a subsequent section. When there are symptoms of injury to the spinal cord itself ('concussion of the spine,' as it is termed), those symptoms constitute the main feature of the case, and will be spoken of presently. In this place I shall speak merely of the uncomplicated sprains.

There is swelling at the injured part, with subsequent inflammation; but generally no visible ecchymosis, since the blood which must have been poured out is beneath the deep aponeurosis. There is great pain in moving, and especially in extending the spine. The prognosis is very favourable, though recovery is often slow. Sometimes, however, disease of the bones or joints of the vertebral column, or low inflammation of the cord, or disease of the kidneys follows on what was apparently a simple sprain; and in some of these cases unsuspected fractures or dislocations have been found. I would refer for some interesting examples of these complications to Mr. Jacobson's essay on Injuries of the Back in the 3rd edition of the 'System of Surgery.' Symptoms.

If, from the severity of the injury, the patient is at all collapsed, the first indication is to revive him from that condition. Then at first moderate general and local antiphlogistics will be indicated, with opiates, mercurial purges, Dover's powder at night, salines, spoon-diet, and leeches. Afterwards fomentation with poppy-heads, warm Goulard lotion, with laudanum, or compresses of tincture of arnica (ʒj to Oj). When the patient is able to move in bed and sit up, friction and stimulating embrocations (liniment. Iodi, Terebinthinæ, Sapiæ, or blistering or painting with iodine, will probably relieve any remaining pain. In obstinate cases an occasional light touch with the actual cautery is very beneficial. Treatment

Fracture or dislocation of the spine is one of the most surely fatal of all accidents. Fracture sometimes affects only some of the processes of the vertebræ—most commonly the spinous—and the mobility of the fractured process is the only symptom necessarily connected with the injury. No treatment is required beyond rest and a bandage. But when 'fracture of the spine' is spoken of it is understood that the continuity of the whole vertebral column is severed. The gravity of the injury does not, however, depend on the fracture itself; for though no doubt the spinal column is the centre for almost all the movements of the body, and its integrity is, therefore, necessary for any active motion, yet Fracture or dislocation of the spine.

this integrity would be restored after fracture, by bony union,[1] as in any other bone, and the solidity of the column would probably not be materially impaired. Fig. 60 is an example of the repair of a fracture of the spine by bony union in a patient who happened to survive long enough for the completion of the process. But the history of the same preparation also illustrates the reason why this injury is so fatal, for the cord in that case was crushed by the fracture, as it almost always is; so that, although the bones united, the spinal symptoms were unrelieved, and pursued their usual course to a fatal termination.

In describing, therefore, the symptoms of fracture (or dislocation) of the spine, I must premise that most of these symptoms are what are called (on p. 114) merely the *rational* symptoms of fracture, i.e. lesions for which we can find no other cause; and that some cases occur in which similar symptoms (or symptoms very nearly similar) appear to be produced by contusion of the cord without fracture; while, on the other hand, there are cases on record in which fracture of the spine has been proved by post-mortem examination to have occurred, yet in which there have been no such symptoms, in consequence of the cord having escaped injury.

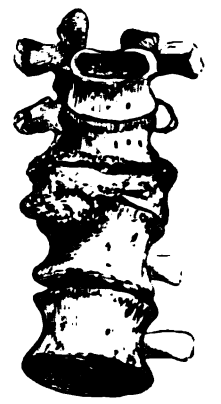


FIG. 60. Fracture of the spine united, the patient having survived five months. The body of the last dorsal vertebra is crushed; some of its fragments are driven forwards, forming an irregular ring of bone which lies in front of the body of the first lumbar, to which it is soldered by bony union. Another large fragment is driven backwards into the canal. The solidity of the column is restored, but with slight angular curvature. From a specimen in St. George's Hospital Museum, Ser. i. No. 49.

The symptoms, then, of fracture of the spine are as follows: pain in the part, aggravated by passive motion, more or less incapability of moving the spine at that part, and deformity of the spinal column. All these are no doubt direct symptoms of the injury; but they are not decisive, with the exception of the last, which, if present in a marked degree, leaves no doubt; but it is frequently absent. There is usually considerable collapse from the severity of the injury. The usual sequelæ, and those by which we infer the existence of fracture, are complete paralysis of motion and sensation in all the parts supplied with nerves from below the seat of the lesion.

In some cases (but I think not very many) there is hyperæsthesia just above the parts in which sensation is lost, depending either on irritation of the nerves as they quit the intervertebral foramina, or of the cord above the disintegrated part.[2] In fracture above the origins of the phrenic nerves (i.e. above the fourth cervical vertebra), that nerve, as well as all the others which supply the respiratory muscles, will probably be paralysed, and death will be instantaneous.[3] With fracture lower down in the neck, the

[1] The occurrence of bony union is denied by Sir C. Bell, and Rokitansky says it is rare — but I believe this is only because recovery is rare.

[2] Hilton's 'Lectures, edited by Jacobson,' p. 64.

[3] A very interesting case is related by Mr. Shaw, in the 'Syst. of Surg.' 3rd ed. vol. i. p. 684, in which a fracture with displacement of the first and second vertebræ was accompanied by no serious symptoms, the fragments being displaced forwards, towards the pharynx instead of backwards on to the cord. The patient died from dropsy a year afterwards, and the preparation is in the Museum of the Middlesex Hospital. The same author (ibid. p. 665) relates a case in which the patient survived fifteen months after a fracture of the fourth or fifth cervical vertebra, though the cord was entirely disorganised at the seat of fracture, and there was therefore paralysis of all the parts below the head. A case is recorded by Dr. May, of Middletown, Conn., in the 'American Journal of Med. Sci.' Oct. 1876, in which the fracture besides implicating the upper vertebræ, traversed the base of the skull also—and where the

patient will retain the power of diaphragmatic breathing, but not the motion of the intercostals or of any other muscle of respiration, or of any of the muscles of the trunk or limbs. Sensation will also be completely absent in all parts below the neck, except that in some cases perception of impressions may still be noted in the parts supplied by the superficial descending branches of the plexus; the sphincters are paralysed, so that the urine is at first entirely retained, and then dribbles over, and there is no power of retaining the fæces; the passage of the catheter, though unfelt, usually excites priapism[1]; and tickling or pinching the limbs, though equally unfelt, also very often produces reflex motions. The intellect is unaffected, and the patient usually free from pain. The temperature of the paralysed part varies. Sometimes it is higher than that of the body; but this is not always the case.[2]

In fractures so high up as this the patient usually dies in two or three days, and often much sooner. Death is produced generally by the accumulation of fluid in the lungs, which the patient is unable to cough up, and which chokes him. But when death follows more rapidly it is probably from hæmorrhage into the substance of the cord or into its theca, which produces pressure on or disintegration of the spinal marrow above the seat of fracture.

The lower down in the column the fracture is situated, the less is the extent of the paralysis. At the lower part of the lumbar region, where there is no spinal cord, but only the leash of nerves of the cauda equina, some of these nerves may escape injury while the rest are torn, and so the resulting paralysis of the lower limbs may be imperfect. Usually, however, in fractures of the lumbar spine the lower limbs and the sphincters are totally paralysed. In the dorsal region there is also paralysis of the abdominal muscles and loss of sensation to an extent corresponding to the seat of the injury, while in fracture of the upper part of the dorsal spine symptoms of difficulty of breathing occur which approach more and more to those produced by fracture in the cervical region.

The later symptoms of fracture of the spine are due to low inflammation of the urinary mucous membrane, and to sloughing of the skin. The urine which dribbles over, or which is withdrawn from the bladder, is at first natural; but soon becomes very offensive, phosphatic and alkaline. For a while it may be secreted acid, and only becomes alkaline from decomposition in the bladder, but after a time it is secreted alkaline in the kidney, the inflammation having extended to that organ. This inflammation is partly due no doubt to the retention of the urine in the bladder, but not entirely so; nor can it be entirely obviated by withdrawing the urine frequently and washing out the bladder with acidulated lotion, although these measures will diminish it. In fact, there is a tendency to low inflammation of all the mucous membranes as

[illegible] were sufficiently displaced to encroach considerably on the foramen magnum, yet the patient recovered. In this paper references will be found to the other cases in point.

[1] 'Priapism will be absent in fractures of the lumbar region where the reflex centre has been crushed, or in severe injuries of the cauda equina, damaging the nerves in which run the sensory irritation and the inhibiting influence between the lumbar centre and the periphery. Priapism is most common after crushes of the cervical and upper dorsal cord; never met with after injuries to the lower lumbar cord.' Jacobson, op. cit. p. 649.

[2] On the temperature after injuries to the cervical portion of the cord see Wunderlich's 'Manual of Medical Thermometry,' translated by Dr. Woodman for the New Syd. Soc. p. 423. If we can trust the observations there recorded, the temperature has been found as high as 111° F. and as low as 86°. In 'Clin. Soc. Trans.' vol. vi. p. 75, may be found a case of laceration of the cord opposite the first dorsal vertebra, where the temperature in the axilla is said to have fallen as low as 80·6° F. See also Mr. Jacobson's essay in the 'Syst. of Surg.' p. 653.

well as of the skin, as a consequence of the deprivation of their nervous influence. This is shown sometimes in the intestines by the tarry condition of the fæces, and the congestion found after death; and probably the low bronchitis which is so constant in fractures high up is not caused by hypostatic congestion alone. So also the gangrene of the skin, though greatly accelerated by pressure, is not due entirely to that cause, as will be stated below.

Apart, then, from complications, the tendency to death in fractures high up is from the pulmonary congestion; in those low down from urinary inflammation or from sloughing.

Dislocation of the spine.

The symptoms of dislocation are the same as those of fracture at the same level, and the cause of death is the same. Thus in the specimen from which fig. 61 was taken, and which is one of pure dislocation at the level at which this injury is most common (i.e. at the root of the neck), the upper vertebra was thrown forward, and the lower backward, and the cord crushed between them. Death took place at the usual period, viz. two days after the accident. And some amount of dislocation is a usual concomitant of fracture, so that the two are always treated of as being practically the same injury.[1] There is, however, one point of practical importance in connexion with the subject, viz. the possibility of diagnosing and reducing dislocation, and the prospect of benefit from such reduction. Most dislocations occur at the lower part of the cervical region, though a few examples are recorded in the dorsal;[2] and I have published an instance of one (of which the preparation is in the Museum of St. George's Hospital) between the last dorsal and first lumbar vertebra in which the dislocation was actually reduced.[3] But the reduction had no effect in relieving the symptoms of paralysis, and it is even possible that the force employed may have been the cause of suppuration which took place around the seat of injury, and which proved the starting-point of general pyæmia. Nor do I see by what signs it is possible to recognise the existence of dislocation apart from fracture.[4] Yet, though the diagnosis may be uncertain, and though it is certainly possible that harm may be done by the manipulation, I still think that when the displaced parts can be returned with tolerable ease into their natural position, it is justifiable to try thus to liberate the cord from pressure, whether we believe the injury to be dislocation or

Reduction of dislocation.



Fig. 61. Dislocation of the spine in the cervical region. The fifth and sixth cervical vertebræ are completely separated from each other, the ligamenta subflava are torn through, and the articulating processes dislocated from each other. The intervertebral substance was lacerated, and the anterior and posterior common ligaments completely torn through.—St. George's Hospital Museum, Ser. I. No. 42.

[1] In Mr. Le Gros Clark's 'Lectures on the Principles of Surgical Diagnosis,' p. 142, will be found the account and drawing of a case in which, along with fracture of the spine, the fifth lumbar vertebra was dislocated from all its connexions, and thrown entirely behind the spinal column.

[2] In all the dislocations, however, below the cervical region which have hitherto been recorded, there has been some fracture of the processes of the vertebræ.

[3] See 'Path. Soc. Trans.' vol. x. p. 219. The patient was under Mr. Cæsar Hawkins's care. Sir Charles Bell seems to have possessed a somewhat similar preparation, but I do not know whether it is still in existence.

[4] Hamilton suggests, as a diagnostic sign, the greater rigidity of the head and neck in dislocation of the cervical vertebræ. See Hamilton on 'Fractures and Dislocations,' 1866, pp. 517 et seq., where the reader will find an excellent account of the cases of alleged reduction of such dislocations.

fracture. And there are doubtless histories of cases in which the surgeon has found an amount of displacement of the spinous or transverse cervical processes which has been evidence to his mind of dislocation, or at any rate displacement of the bodies of the vertebræ, and which has been remedied by extension, the patient regaining perfect health. The histories of such cases previously published are, as I remarked in former editions of this work, in many respects of doubtful value; but I think Mr. Van Buren's case, related in the 'Lancet,' vol. ii. 1882, p. 619, must be admitted as an indubitable instance of recovery from imminent death, due to dislocation of the cervical spine, by the reduction of the dislocation. The patient was a lad who had fallen a distance of over 20 feet, on the nape of the neck. When admitted he was completely paralysed in all the extremities, and had abdominal respiration and priapism. An hour and a half afterwads he became rapidly worse, cyanosed, stertorous, and unable to swallow. Mr. Van Buren found marked prominence of the 5th cervical spine and displacement of the vertebra. With the help of the nurse he brought the parts into position. 'The vertebra went in with a distinct snap, and all prominence and displacement disappeared.' The lad rapidly recovered, and when seen two hours afterwards he could move his arms and legs, and said he felt quite well. He left the hospital eventually in perfect health. In any case in which the surgeon thinks it right to attempt reduction, all possible gentleness and caution should be used, and if moderate force is unsuccessful the attempt should be abandoned.



Fig. 62. Fracture of the spine—to show the displacement which very commonly takes place of a portion (or, as in this case, almost the whole) of the body of the vertebra into the spinal canal. The fractured and displaced vertebra is the seventh cervical. The intervertebral substance between the sixth and seventh cervical vertebræ was ruptured, and their laminæ separated from each other by rupture of the ligamenta subflava, i.e. the fracture was complicated with dislocation, as so commonly occurs. The cord in this case was entirely disintegrated from a point opposite the fifth cervical to the third dorsal vertebra.—St. George's Hospital Museum, Ser. i. No. 56.

Trephining the spine.

This leads us to the consideration of the treatment of fractured spine. In the first place, if the displacement cannot be remedied by extension and counter-extension, can it be by surgical operation? The proposal to 'trephine the spine'—i.e. to attempt, in one way or another, to elevate the portions which have been depressed on to the spinal marrow—has been sustained by the supposed analogy of depressed fractures of the skull, and has received the support of many famous surgeons. It is not becoming, therefore, to speak of it with disrespect. But the assumed analogy is obviously a very deceptive one, and I can find no evidence that the operation has ever been really in any degree successful; while, if unsuccessful in its object, it must tend to hasten death, for it is undeniably a very severe proceeding, requiring a long and deep incision through a large mass of muscles, and thus exhausting the patient by hæmorrhage when the rational indication of treatment is to spare his strength in every possible way. There is, in fact, little analogy between the indications which lead the surgeon to trephine the cranium and the conditions present in almost every case of fractured spine with displacement. In cases suited for the operation of trephining the skull, the brain is compressed at a single definite

accessible part (of no great extent compared to the volume of the brain) by a small portion of depressed bone or by a foreign body; but its own proper tissue is believed to be only very slightly or not at all injured. In fractures of the spine, on the other hand (as may be seen in fig. 62), the displacement is generally due to projection of a portion or the whole of the body of a vertebra, and sometimes of more than one vertebra, into the spinal canal, at a part utterly inaccessible, crushing and disorganising the whole spinal cord to an extent which cannot be remedied by the removal of the cause which produced it.[1] Very often the cord is entirely divided at the seat of fracture. No judicious surgeon would think of trephining the skull if he believed that the brain was hopelessly lacerated—far less if he thought that there was in all probability a large mass of bone sticking into it at the base of the skull. Dr. Brown-Séquard tries to meet this argument by urging that though the laminæ and spinous processes are the only parts which are accessible for removal, yet the removal of these from behind will liberate the cord from the pressure of the displaced bone in front. Even if this were so, however, it would leave a rugged fragment irritating the cord, and the prospect of benefit would not justify the additional irritation produced by the operation. It is quite true that there are cases in which the displacement of bone is less than that shown in the figure, and that the cord is not always hopelessly disorganised; but it is also true that in such cases the patient has a good prospect of survival, and it seems that under such circumstances an operation is more likely to prove the starting-point of inflammatory softening than to cure the patient. Dr. Gordon's case,[2] though an interesting one, and though some improvement seems to have followed the operation, cannot be quoted as successful, since the paralysis remained permanent; and although the operation has been repeated many times since, in no case does it seem to have been of unmistakable service. Exceptional cases may occur in which, from the nature of the accident or the appearance of the part, the surgeon may think that only a small amount of bone is implicated in the injury, and where he may determine to give the patient the poor prospect of relief which this operation holds out; but in general it will only hasten the end.

Treatment of fractured spine.

The treatment of fractures of the spine must be directed to combat the two main dangers to life which can be met by surgical treatment, viz. the

[1] The only part of the vertebral column which is completely accessible and which can be fairly removed, when depressed on to the cord, is the arch or lamina. Now, this is the part which is the most seldom affected. Mr. Le Gros Clark says:—'Of the many cases of fractured spine which I have on record, and which I have examined *post mortem*, I cannot recall an instance in which the depression of the arch *alone* sufficed to account for the symptoms. I am aware that such cases are recorded, but I speak only of my own experience, and therefore I conclude that they are rare.' He goes on to show that even when the injury is a direct blow on the back of the spine, the cord is in all probability disintegrated beyond recovery. The whole discussion of this topic in Mr. Le Gros Clark's 'Lectures on the Diagnosis of Visceral Lesions,' pp. 187 et seq., is well worthy of perusal. The conclusion is as follows: 'I fear we must abandon this operation. . . . To weaken still further the remaining connexions of a broken spine; to convert a simple into a compound fracture; to expose the sheath of the cord, and possibly the cord itself; and to entail the risks attending the period of repair—cannot be regarded as circumstances of indifference. Accidentally, here and there, an instance may occur in which benefit does, or seems to, result from surgical interference; and the time may arrive when, perchance, the means of diagnosis at our command may enable us to judge with more precision of the nature and extent of the injury inflicted; but at present I cannot regard trephining the spine as brought within the pale of the justifiable operations of surgery.' The reader is also referred to the elaborate discussion of this subject in Mr. Jacobson's essay, where all the recorded cases are tabulated.

[2] 'Med.-Chir. Trans.' vol. xlix. p. 21.

tendency to cystitis, and that to sloughing; the other and still more formidable danger, from loading of the lungs, is unfortunately irremediable; but it only occurs in fractures high up. The tendency to cystitis may be partly obviated by the careful and frequent use of the catheter, and by gently washing out the bladder with acidulated water; but there is a strong disposition to low inflammation of all the mucous membranes, and especially that of the urinary tract, in this accident, so that the relief afforded can only be partial.[1] As the patient is not sensible to the pain of rough catheterisation, injury may easily be done unless great care is taken. But if catheterisation be neglected the inflammation may prove fatal by spreading up to the kidneys, or (as I saw in one case) by perforation of the bladder. Sloughing is a very frequent cause of death. Sloughs form on all parts exposed to pressure, but also on places (as the malleoli), where no pressure seems to have acted; so that there can be no doubt that the privation of nervous influence acts as a cause of the gangrene, as well as pressure, though the latter is a very powerful agent in producing the sloughing; and the tendency to this inflammation is much increased by neglect in nursing, whereby urine and fæces are left in the bed to irritate the skin. Scrupulous cleanliness, frequent slight changes of position, which can be effected by means of pillows inserted here and there, and by gently rolling the patient to one side or another, and the use of the water-bed or water-pillow, are necessary in order to give the patient a fair chance of recovery. It would seem useful to give support to the injured portion of the spine by a splint made of gutta-percha, gently moulded on to the back, and secured round the body, and several cases of recovery have been recorded under the use of the plaster of Paris jacket, especially in fractures of the dorsal and lumbar regions. It seems best to apply this after the first tendency to bedsores has passed over—say about a fortnight after the accident, but it has also been used immediately with success.[2]

The prognosis as to recovery depends on two considerations; viz. 1, on the extent of the injury to the cord, as indicated by the completeness and immediate onset of the loss of its functions; and 2, on the level of the injury. Numerous examples are recorded in which, at various levels, the vertebral column has been fractured, yet the cord has escaped more or less entirely and the patient has survived; or where the symptoms have been at first partial, and then complete paralysis has supervened either from hæmorrhage, from inflammation, or possibly from the pressure of callus effused round the fracture, and this paralysis has subsided more or less completely and the patient has recovered. Many of these cases are quoted in Mr. Jacobson's essay, and one of the most remarkable is recorded by Mr. Jordison in the 'Lancet,' 1882, vol. ii. p. 658. And finally there are many cases, low down in the spine, in which the patient survives, more or less completely paralysed. Mr. Jacobson goes so far as to say with regard to fractures of the lumbar spine, 'If the patient can be safely tided over the stage of bedsores and urinary troubles, it may be confidently expected that he will recover, and be able eventually to follow some light occupation.'

Wounds of the vertebral column.

Penetrating wounds of the spine do not necessarily involve any injury to the spinal marrow. I have recorded some cases ('Med.-Chir. Trans.' lxv. 155), in which the theca vertebralis has been opened by a stab, and large quantities of the cerebro-spinal fluid have escaped without giving rise to any serious

[1] Those who hold the germ-theory of disease dwell on the advantage of using carbolised oil for the catheter in such cases as these, and there can certainly be no harm in doing so.

[2] See Jacobson, op. cit. pp. 670–673.

symptoms. If, on the other hand, the cord is wounded, the symptoms will of course vary with the extent and position of the lesion. The cases hitherto published will be found in Dr. Brown-Séquard's works, and in Mr. Jacobson's essay. The prognosis is not quite so unfavourable as in fracture if the wound be carefully closed at once, and absolute rest enforced until all inflammatory symptoms have subsided, or are no longer to be apprehended.

Concussion of the spine.

Concussion of the spine is a term which is applied to cases in which after injury the functions of the spinal cord are more or less lost, but without any evidence of fracture. The injuries which produce concussion of the spine vary greatly in severity, and the symptoms vary also from slight numbness, pricking sensations, or difficulty of motion, to an amount of paralysis both of motion and of sensation as great as that of fracture, though commonly not so persistent. The anatomy of concussion must vary also to a corresponding extent. Frequently, I have no doubt, the lesion consists in hæmorrhage external to, or in the substance of the cord, sometimes most likely in laceration of the cord, and at others possibly in inflammatory effusion or inflammatory softening. That cases ever occur in which the tissues of the spinal marrow and its vessels are uninjured, as would be implied by the term 'concussion,' if rigidly interpreted, is as unproved in the case of the spine as of the cranium.

The symptoms to which the term concussion of the spine is applied come on either immediately on the injury or after an interval of uncertain duration. I do not know that I can do better than quote two of the cases which Mr. Le Gros Clark gives as instances of concussion of the spine following in one case immediately, and in the other subsequently to an injury. 'A man 36 years of age, weighing 11½ stone, was tripped up in the road, and fell heavily on his left hip, and then turned over on his back. On trying to rise he failed, not having any power of movement in either lower extremity. He was brought at once to the hospital. On admittance he complained of pain in the lumbar region, and there was slight tenderness in pressing the spinous ridge of this part; but careful examination failed to detect any irregularity or other sign of mechanical injury of the vertebral column. There was entire loss of power in his lower limbs; he could not even move a toe; sensation was impaired; he said his legs were numbed. There was slight priapism, and he was unable to micturate. His pulse was 60, but there were no signs of well-marked collapse. On the third day he was able to move his toes a little. On the ninth day sensation was perfect, but he had made very little progress in regaining muscular power. Nearly three weeks elapsed before he was able to dispense with the catheter; and at the expiration of five weeks he was still almost as helpless in moving any part of his lower extremities. He remained in the hospital for four months, his health being tolerably good throughout. He was then able to get about very fairly, but with a shuffling, unsteady gait.'

The diagnosis of a case of this sort from one of fracture will rest partly, as Mr. Clark observes, on the absence of the local signs of fracture, and on the fact that the accident is not one likely to have produced fracture, and partly on the partial extent of the paralysis. Yet, as he adds, 'in some cases where the symptoms are persistent, doubt must remain as to the true nature of the lesion, and a cautious prognosis is therefore required.'

The case in which symptoms of spinal concussion followed after an interval is as follows:—'A man was injured in a collision in the tunnel four or five miles from Brighton. He walked this distance with some difficulty into the town, and within twenty hours became entirely paraplegic. He recovered

slowly: and after a lapse of two years was able to walk as well as before the accident. One spot in the back was always tender,' and continued so at the time of the report, which was, I believe, about five years after the injury.

Cases of spinal concussion have acquired great surgical and even public interest of late, from the frequency with which they really occur, and from the frequency also with which they are alleged more or less falsely to have occurred, in cases of railway injury. No part of a surgeon's duties is more difficult than that of forming an opinion in these cases, in which the alleged symptoms are sometimes entirely fabricated; at others mixed with more or less of unconscious exaggeration or delusion, the result of mental causes; at others really existing, but in so latent a condition that it is hardly possible at first to believe in their reality. It is, therefore, no wonder that the most eminent surgeons constantly differ in their estimate of such cases, and that they constantly make opposite errors by denying the reality of symptoms which the after-progress of the case shows to have been perfectly genuine, or by accepting others which are fraudulent or imaginary. No doubt as this class of cases becomes more familiar such differences of opinion will become rarer; and they would even now be far less common if the system of our courts of law would permit of a deliberate examination and report by a medical commission authorised to avail themselves of all necessary opportunities for pronouncing an unbiassed judgment. As it is, both sides in the trial have an interest in procuring medical testimony on hasty examinations from which one aspect of the case has been concealed as far as possible.

Railway injuries are not usually pure examples of concussion of the spine, but the spinal injury is mixed up with symptoms of general shock, besides, as may easily be the case, definite lesions of other parts of the body. I will again quote from Mr. Le Gros Clark, who speaks thus on the subject of railway injuries affecting the spine: 'Spinal concussion may be immediate and well-marked; or the indications of spinal mischief may not supervene until after the lapse of some time. General shock is often, but not always, in excess of that which accompanies simple concussion; in some instances the collapse is great, accompanied by insensibility, but without evidence of injury to the head. Reaction, under such circumstances, is tardy and irregular. Numbness and tingling, sometimes local, sometimes universal, is complained of. Other symptoms are, rigor, continued sickness, intermittent fits of numbness, excito-motor spasm in the limbs, violent throbbing sensations, or sense of heat or cold in the head or other parts, want of sleep or continued drowsiness, confusion of intellect, enfeebled muscular power, deafness, defective sight, accompanied by ocular spectra; hyperæsthesia in some parts, but especially in the spine; great emotional excitability. Besides these, I could enumerate other more especial symptoms; but they have been peculiar to isolated cases. With rare exceptions, extreme sensitiveness of the spine is present in these cases, and more frequently located at some particular part than distributed over the whole column. Again, this pain on pressure is sometimes referred to the lumbar muscles, at others to the spinous ridge. In some of these cases the patients entirely recover after a longer or shorter interval; in others the health is permanently enfeebled, and a life of protracted discomfort is entailed; or the sufferer sinks, emaciated and exhausted, into a premature grave; or becomes the victim of some acute disease, the destructive tendency of which his defective organism is incapable of resisting.

'It will be perceived that many of the foregoing symptoms and signs may be referred to what we are accustomed to regard as concussion of the spine

but many also are due to general rather than special nervous shock. In some instances there is probably meningeal mischief; but the indications in others clearly point to organic change in the cerebro-spinal centre.

'I have already shown, in a preceding lecture, how powerful an influence emotional shock or physical concussion may exercise on organic vitality; and I think it not inconsistent with acknowledged facts to affirm that protracted functional disturbance, or even fatal disease, may be the consequence of a rude shock simultaneously to the nerve-centres of the emotions, of organic and of animal life. I am, therefore, disposed to regard these cases of so-called railway spinal concussion as, generally, instances of universal nervous shock, rather than of special injury to the spinal cord. At the same time I admit that in this class of cases we meet with instances of simple concussion, but I see no reason for taking them out of the category of concussion of the spine from other causes.'[1]

Mr. Clark gives also an account of the post-mortem appearances of the spinal cord in two cases, one, under his own care, in a child who had sustained an injury to the spine without fracture, and not producing paralysis at first, though this soon afterwards supervened. The child died three months afterwards with inflammation of the whole cord below the eighth dorsal vertebra. There was no trace of hæmorrhage nor of disease of the membranes, but the spinal cord was replaced by a mere 'string of soft atrophied nerve-matter.' In the other case, which was under the observation of Dr. Lockhart Clarke, and is published by him in the 'Path. Soc. Trans.,' vol. xvii., the case was one of ordinary railway injury, the patient having survived three and a half years. His gait had been 'unsteady, somewhat like partial intoxication, but without jerking or twitching;' and latterly his speech had become thick and hesitating. The spinal cord was wasted and shrunken, and its white matter showed evident traces of inflammatory degeneration.[2] The brain was also pallid and soft, particularly on the under surface of both anterior lobes.[3]

Diagnosis of spinal concussion.

It would be impossible in a work like this to go fully into the very difficult problem of the diagnosis of cases of railway injury. The subject is treated of with conspicuous ability in Mr. Erichsen's well-known work on 'Railway Injuries,' to which I would refer the reader for a more adequate view of the symptoms, pathology, and treatment of these difficult cases than my limits allow. I would only say here, that when there is any doubt of the patient's veracity or of the reality of the symptoms in all cases of alleged inability to perform certain movements, it is most satisfactory to have physical evidence of the wasting of the muscles concerned in those movements, or other tangible proof of the effect of the loss of function. The effects of the galvanic current applied to the muscles alleged to be affected must be carefully watched and compared with its effects when applied to those of the other side. When loss of sensation is alleged it is desirable to examine the patient in many ways, and with his attention distracted from the part in which sensation is said to be deficient. Unsteadiness of gait may easily be simulated, and the fraud may be detected when the patient is cleverly thrown off his guard. Alleged loss of power over the bladder ought to produce certain symptoms and appearances in

[1] Op. cit. p. 150.

[2] A drawing from a microscopical section of the affected cord will be found in Mr. Le Gros Clark's work.

[3] Mr. Jacobson quotes two other cases from Dr. Gowers ('Med.-Chir. Trans.' vol. l.) and Sir W. Gull ('Guy's Hospital Reports,' 1858). Both, like the two above quoted, show the results of chronic inflammation of the cord and its membranes.

the urine, and a urinous smell about the clothes and bed; and finally, all the more serious cases of injury are accompanied with a disturbance of the general health which is often 'conspicuous from its absence' in persons who prosecute claims against railway companies. But besides the grosser and more easily detected cases of fraud instances are met with often in practice in which the mental and bodily symptoms are so mingled together that it is hardly possible to say what is the real injury and what is the patient's prospect of recovery.

Prognosis. The prognosis of these injuries is also a very difficult question. Those which come on at once, and with symptoms of active hæmorrhage, seem to me on the whole more encouraging than those in which the mischief is consecutive on inflammation, probably accompanied by textural changes (softening in most cases, in others induration); and if, as is sometimes the case, the inflammation spreads upwards, and symptoms of cerebral meningitis or softening begin to make their appearance, the prospect of recovery, or even of amelioration, becomes still worse. Much also will depend on the state of the general health. Those cases are the worst in which the patient's condition goes on deteriorating, and unluckily they are by no means the least common.

Mr. Page, in his recently published work on 'Injuries of the Spine and Spinal Cord,' has adduced the history of a very large number of railway accidents, to show in how small a proportion of these cases are the central nervous structures really damaged. He regards the great majority of them, so far as they affect the spine, as being sprains of the joints of the vertebral column, followed by what he calls 'traumatic lumbago,' a low form of inflammation, which, as a rule, is not propagated to the structures in the vertebral canal, and which is almost sure to yield, though slowly, to treatment. On the other hand, he believes that cases in which serious spinal symptoms testify to the existence of anatomical lesions of the spinal cord recovery rarely ensues even with loss of function; but the normal tendency is to progressive degeneration and death, as in the cases quoted on the previous page.

Treatment. The treatment of these cases at their commencement must be by rigid rest and by antiphlogistics—much as in severe sprain; and Mr. Erichsen with great probability suspects that many of the ill consequences which often follow on railway injuries depend on the patient having neglected at first to observe that perfect quiet which should always be enforced after such an accident. When the first acute symptoms have subsided, much benefit will probably be produced by counter-irritation and the actual cautery, and by the cautious administration of mercury in very small quantities, the perchloride being the favourite preparation. When all inflammatory symptoms have subsided, the use of strychnia is indicated, and electricity—the continuous current being in general more beneficial; and it is possible that then the patient may derive benefit from gentle exercise with all possible caution. The general health must, of course, be carefully attended to, and when he is able to move the patient may be advised to try the effect of change of climate.

CHAPTER IX.

INJURIES OF THE FACE.

Wounds.

THE free vascular supply which is enjoyed by all parts of the face renders the process of union rapid, and the prognosis of all injuries better, in this than in any other part of the body. It is true that cutaneous erysipelas is common, but it seldom produces alarming symptoms except in persons whose health is broken down by intemperance or visceral disease. Bruises are often extensive, since the large vessels lie close under the skin, surrounded by a loose cellulo-adipose structure, in which extravasation can go on to an almost unlimited extent; but it speedily subsides if the patient is in good health. All wounds ought to be immediately and accurately united, with sutures if the edges cannot otherwise be kept in exact apposition; and the sutures must be supported with harelip-pins when the flaps are heavy, or in the lips, where powerful muscles are attached to the skin. Even if the wounds be considerably contused or lacerated they may nevertheless be united. Perhaps no sloughing will ensue, or if the edges slough still the resulting deformity will most likely be less than if the flap had not been replaced. But sutures will very likely leave a mark of their own, so that they should not be used unless absolutely necessary; they should be as delicate as is consistent with security, and they ought always to be withdrawn as early as possible. Even in adults and in the lips there is no reason for leaving the harelip-pins in longer than forty-eight hours.

Salivary fistula.

One of the most disagreeable complications of wounds of the face is salivary fistula. This is caused usually by a wound, but sometimes by an abscess, which lays open Steno's duct. The saliva is constantly running out on the cheek, and the flow is increased when the patient eats or when his 'mouth waters.' If the division is complete the patient may be conscious of dryness of that side of the mouth.

In some cases mere cauterization of the fistulous orifice, or refreshing its edges, will suffice to effect a cure. When these means fail, the disease must be treated by restoring the passage for the saliva from the gland into the mouth. For this purpose the proximal part of the duct (i.e. the part of the duct which is still in connexion with the gland) should be found by examination of the wound; then the cheek should be everted, and along the natural opening of the duct, in the interior of the mouth (which is generally found without difficulty, opposite the second upper molar tooth), a probe or leaden string is to be passed across the wound and along the duct in the direction of the gland.[1] The probe or string is fixed in its position by bending its extremity round the commissure of the lips on to the cheek, where it can be secured. When the saliva is thus guided into the mouth the fistula will probably heal, either of itself or on its edges being refreshed and brought together. In some cases the opening of the duct in the mouth cannot be found, and when this is the case the distal opening of the duct as well as the proximal must be sought in the wound; or if that part of the duct is obliterated, an artificial passage must be made and kept open;

[1] Mr. H. Morris has used a catgut bougie for this purpose with success.—'Clin. Trans.' vol. xiii. p. 144.

but such cases are far less promising. And indeed many cases of salivary fistula present very considerable difficulty, from the rottenness of the tissues surrounding the wounded duct, which renders them very unapt to unite when brought together, and favours the percolation of the saliva through the wound which it is intended to unite. In such cases the following method may be tried. 'The patient being seated with the head well supported by an assistant, a strong broad wooden spatula is introduced within the cheek of the affected side; this is held firmly by the assistant. The wound being then slightly elongated by incising its sides in the line of the zygomaticus major muscle, a round punch, like that used by saddlers, should be placed over the fistulous orifice, care being taken to avoid the anterior edge of the masseter muscle. Then, on pressing the punch firmly against the spatula within the mouth, a piece of the entire thickness of the cheek will be removed, and a fresh opening made directly into the mouth. The external wound, being accurately closed by sutures and adhesive strips, will usually heal kindly, and the internal opening be found to give free vent to the saliva.' [1]

Foreign bodies in the nose and ear.

Children very frequently pass foreign bodies into the nose or ear, which they cannot withdraw again, and which afterwards may set up grave mischief. In the nostril they give rise to foul discharge, from inflammation of the membrane, and may even produce disease of the bones. The case is constantly mistaken for one of 'ozæna,' or strumous disease—so constantly that it has become a familiar caution in surgery always to put down a case of foul discharge from one nostril in a child as being probably due to a foreign body, and to pronounce no opinion about it till after a thorough examination, for which purpose anæsthesia is generally necessary. It is always quite easy to remove the foreign substance either from the nostril or by pushing it through into the throat, and then the discharge will at once subside.

Foreign bodies in the meatus auditorius are more dangerous, for they may easily cause perforation of the membrana tympani, or even cerebral mischief, by inflammation spreading through the base of the skull to the cranial sinuses. Such foreign bodies may be removed by constant syringing with warm water, or under chloroform with a pair of forceps, a bent probe, a loop of wire, or some special instrument of which several have been devised for the purpose. But if these means fail, as they often do, nothing further should be done, beyond perseverance in syringing, since harm may easily be produced by the incautious use of instruments, and in all probability suppuration will loosen the foreign substance, and then it will come away. On this subject, an interesting statement from Mr. Dalby will be found in the 'Brit. Med. Journ.,' Dec. 15, 1877. Mr. Dalby says that no foreign body in the ear can possibly do any harm if left alone, except living insects and vegetable substances, which rapidly swell from absorption of water, but that he sees constant instances of rupture of the membrana tympani from incautious or bungling attempts to extract them, and that even fatal consequences may ensue. All attempts at extraction are in his opinion unjustifiable unless the operator have learned to use his two hands, while the external meatus is thoroughly illuminated by a mirror, worn on the forehead.

Fractures of facial bones.

The bones of the face can only be fractured by direct force, and these fractures are not so frequent as might be expected. One observation which it is necessary to bear in mind in these injuries is that the distinction which in other regions is so important between simple and compound fractures has really

[1] Mason, 'Am. Journ. Med. Sci.' July, 1880.

hardly any importance as applied to the bones of the face. Wounds of the face heal so rapidly, and the thin facial bones are so surrounded by structures rich in vessels, that compound fractures heal almost as readily as simple fractures do.

Of the ossa nasi.

The ossa nasi when fractured are usually also depressed, causing a flattening of the bridge of the nose and a very unpleasant deformity. The accident is a very easy one to recognise, but the treatment is not always satisfactory, for these delicate bones are often comminuted as well as fractured, and it is very difficult to adjust the fragments properly.

All possible care, however, should be bestowed on the restoration of all the fragments to their proper position, by means of a curved staff or a female catheter introduced up the nostril. If it is otherwise impossible to keep the fragments in their place, the surgeon may try to support them by some substance introduced into the nostril; but Mr. Holmes Coote justly says that 'plugging of the nostril should not be resorted to except in cases of severe displacement, for it causes the patient great discomfort, and not uncommonly fails to effect the purpose for which it is used.' If it is found necessary to introduce a foreign body, it should be removed after a few days. The fracture unites very rapidly. In some cases the cartilages only are broken or bent. The treatment, however, of these cases must be conducted on the same principles. The septum is of course usually involved in the fracture and displacement, and great care must be bestowed in order, if possible, to keep it straight while the process of union is going on. When the case is first seen the septum should be straightened by means of a flat pair of forceps, and the broken pieces of the nasal bones replaced. In a case under my care in which there was great deviation of the nose, I obtained a very good result by the use of a frame adapted to the head, and carrying two flat plates, something like the blades of a pair of flat forceps, between which the nose was kept evenly and comfortably supported for about three weeks, till all tendency to lateral displacement had disappeared. In other cases an apparatus like that figured in Mr. Spencer Watson's work[1] may be employed to make pressure on the projecting bone and gradually restore it to its natural position. Mr. W. Adams[2] has described a screw steel apparatus for supporting the fragments in these cases, which is to be worn for two or three days, and then replaced by an ivory plug. And, no doubt, in some complicated cases the use of a metallic or glass support is necessary; though in those where the fracture is only single, and the septum is not much deviated, it may be superfluous.

Of the upper jaw.

Fractures of the upper jaw are accidents of little moment unless the displacement is such as to produce much change in the features. I remember a case in which, a carriage-wheel having passed over the face, most of the bones seemed to be separated from the skull, and on recovery a peculiar and most disagreeable lengthening of the face was left. Such deformities are very difficult indeed to avoid, for there is little means of acting on the upper jaw from any side so as to replace its fragments when once driven in.

Of the malar bone and zygoma.

Fractures of the malar bone are rare, and are usually caused by considerable violence. The only point of interest in their pathology is one illustrated by a case which I published many years ago,[3] where a gentleman who had fallen from his horse and had sustained fatal injury to the brain presented an orbital ecchymosis exactly resembling that which attends on a fracture of the base of

[1] 'On Diseases of the Nose,' 1875, p. 308. [2] 'Lancet,' 1875, vol. i. p. 649.
[3] 'Brit. Med. Journ.' 1855, p. 967.

the skull. On post-mortem examination the bleeding was found to depend on a fracture traversing the malar bone near its junction with the frontal.

Fracture of the zygoma is exceedingly rare, and it is said that in some cases displacement is produced by the action of the fibres of the masseter muscle implanted into the fractured part, but I have no personal experience of this injury. The displacement, when recognised, must be remedied by careful manipulation under anæsthesia. Replacement by the insertion of a sharp metallic point into the displaced fragment and traction upon it has been spoken of.

Of the lower jaw.

By far the most common fracture in the face is that of the lower jaw. This is usually caused by a very heavy blow, such as the kick of a horse, though as curiosities cases are recorded in which muscular action is said to have caused it. It is frequently in some sense compound, that is, the line of fracture communicates with the air in the cavity of the mouth, for the soft coverings of the jaw are very commonly torn. But the fracture almost always unites after the manner of a simple fracture. In some complicated injuries, however, the comminuted portions will exfoliate. Any part of the bone may be broken. There are cases in which only the alveolar edge is broken off, but the continuity of the bone is not interrupted, since its base is not broken. Such accidents are rare in the present day, but were said to be common when 'the key' was in ordinary use in extracting teeth. Mastication will be painful or impossible at first, but as the parts consolidate the patient will completely recover, though perhaps with the loss of some of the teeth. Another rare fracture of the jaw is that of its neck.[1] It is not difficult to diagnose, by following the ascending ramus upwards with the finger introduced into the mouth. I once dissected a specimen of this injury in which the broken ramus had protruded through the meatus auditorius externus, and had so irritated its lining membrane as to give rise to a catarrhal discharge very much resembling that which is seen in some fractures of the base of the skull.[2] Another fracture is that through the angle between the body and ascending ramus, and in this there is not much displacement, since the masseter and internal pterygoid inserted on either side keep the parts in position. The fractures which occur between the angle and symphysis are generally much displaced, and especially when, as very commonly happens, there is fracture on both sides—the central piece being drawn down by the hyoid muscles in addition to the displacement caused by the force of the blow. Fracture often traverses the bone at or close to the symphysis, and this fracture will not be much displaced unless the force has been unusually severe, since the muscles of the two sides will balance each other.

Fracture of the coronoid process is a rare accident, but one which is illustrated by a preparation in the Museum of King's College Hospital, of which Mr. Heath gives a representation, copied from Sir W. Fergusson's 'Practical Surgery.' The former author thus speaks on the subject of this rare injury: 'The fragment would, no doubt, be drawn upwards and backwards by the temporal muscle, and might be felt in its new situation, though this displacement would probably be limited by the very tough and tendinous

[1] Mr. Heath says that, judging from the number of Museum specimens which exist of it, this injury is probably not so uncommon as it is represented. I can only say that it is rarely met with in extensive hospital practice, where other fractures of the jaw are common.

[2] 'Path. Soc. Trans.' vol. xii. p. 159.

fibres which are so closely connected with the bone, forming the insertion of the temporal muscle and reaching down to the last molar tooth. According to Sanson fractures of the coronoid process do not admit of union.'[1] I venture to think that the latter statement is entirely unsupported, and that the idea that fractures of the coronoid process of the jaw do not unite by bone—though it has been copied from one author to another till it has become one of the *loci communes* of surgery—rests on no evidence. If the fragment were much drawn up the fracture would unite by ligament; but there is no proof that this displacement usually occurs.

Fractures of the lower jaw are often multiple or comminuted. This is the case, of course, in gunshot fractures almost always, but not infrequently in those caused by the passage of wheels over the face or by other unusual violence. And the nature of the displacement, as well as the amount of deformity resulting, is greatly influenced by this circumstance. It is mainly in these more complicated fractures that non-union is to be apprehended.

The state of the teeth should always be carefully considered in cases of fractured jaw, and any which are so displaced as to interfere with union, or so injured as to be useless, had better be removed at once.

Diagnosis and treatment.

The symptoms of fractured jaw are usually very plain. The patient will feel very great pain in trying to open his mouth, the saliva will very probably drivel, the line of the teeth will be broken, and one or more will very likely be loose or be knocked out; there will be displacement as described above, and crepitus will be easily felt on manipulating the parts into position. If the fracture be comminuted, the diagnosis will be still more easy.

The treatment consists in replacing the parts by proper manipulation, which is seldom difficult in uncomplicated fracture, and then in the simpler injuries nothing further is necessary than to put up the parts in a jaw-bandage, i.e. a four-tailed bandage, with a hole cut in the centre to receive the chin, the tails crossing each other, one pair tied behind the occiput (sometimes for more security brought thence over the forehead), the other over the vertex. Inside this may be placed a guttapercha or pasteboard splint moulded so as to fit the chin.[2] The teeth of the lower jaw are thus brought into close apposition with those of the upper, which serve in some measure as a splint for them, fixing them in their natural position. For the efficiency of this treatment it is clear that the teeth must be kept together, i.e. that the patient must not be allowed to open his mouth. He must, therefore, be content with such fluid or semi-fluid nourishment as he can suck in through any gaps there may be in his teeth or can pass in through the hiatus behind the molars. After the first fortnight perhaps a little movement of the jaw may become tolerable. In a period of from three to four weeks from the accident the parts will become sufficiently united to dispense with the bandage, but the patient may prudently wear a handkerchief, in order to prevent his opening his mouth too far or using the teeth too violently.

Complicated fractures of the jaw are sometimes very hard to deal with. If sound teeth remain on both sides of the line of fracture a piece of wire may be passed round them tight enough to draw the fragments together, and this is often a useful way of fixing a comminuted piece, but the wire should only be

[1] 'Injuries and Diseases of the Jaws,' 2nd ed. p. 14.

[2] An oval piece of pasteboard is taken of appropriate size, and a cut is made on either side in the long axis of the oval, leaving a part in the centre undivided. The pasteboard is softened, and this central part is moulded on to the chin, while the divided ends overlap each other and hold the splint in place.

left for a few days, for it has a great tendency to cut into and injure the teeth. Mr. H. O. Thomas of Liverpool has dwelt strongly on the advantages, in cases of compound and much-displaced fractures, of wiring the fragments together, for which purpose he either drills a hole through the fragments and passes an annealed silver wire $\frac{1}{32}$ of an inch in diameter through both of them, or passes the wire over or through any teeth which may be left firm enough to bear the strain. The wire is then so twisted at either end as to allow of its being tightened (which will become necessary in a few days, from the subsidence of effusion between the fragments), and also of easy removal.' The advantages claimed for this method are greater nicety of adaptation and more comfort to the patient, who is able to masticate easily.[1] In the case of non-union of fractures, I have already spoken of the benefit which is often derived fron pegging or drilling the fragments together (page 126). Where the teeth, or most of them, remain in the jaw, and where the bone is not much comminuted, it seems that Hammond's splint is the most useful and the easiest to manufacture. Its application is thus described by Mr. Jacobson:[2]—'While the patient is under an anæsthetic, the teeth on either side of the fracture being tied together temporarily, and the fragments firmly supported, a frame of strong iron wire is, by means of small curved pliers, adjusted to the fractured jaw by being bent so as to encircle all or any desired number of teeth on a level with their necks. A plan very much to be preferred is to take first a soft wax impression of the teeth, then to cast this in plaster of Paris and to adjust the frame on the cast. The frame, the ends being joined by silver solder, is then slipped over the teeth, steadied by an assistant, while it is tied in place by short pieces of much thinner wire passed round each tooth and interlacing with the frame. These pieces of wire should be pointed obliquely, so as to pass easily between the teeth, especially where the intervals between the necks are very narrow, as in front. If by accident they are here and there passed through the gum itself it will not intefere with the action of the splint. The ends of each of these binding-wires are then twisted up in front, at first nearly tight, four or five wires on each side of the mouth being inserted and partly tightened. The wires on each side of the mouth are taken alternately, and finally tightened so as to exert equal pressure, care being taken not to overtwist and break them. The twisted ends are then cut short within about a quarter of an inch of the necks of the teeth, and turned downwards so as to be beneath the frame itself, and in close contact with it.'

In cases where there is much comminution these simpler plans will not succeed, and there is much danger either that the fracture will not unite at all or that great deformity will result. In such cases a mould must be constructed of vulcanite, or better in thin metal, silver or gold. Such moulds are made on one of two principles, i.e. they either use the teeth of the upper jaw as a base on which the mould is fixed above, while its lower part carries cavities for the reception of the teeth of the lower jaw, and they are confined in those cavities by a splint and bandage externally, the mould itself being attached to the chin by an arm at either corner of the mouth, or else the support of the lower jaw is dispensed with—a frame is moulded to the chin; an arm projects from this frame on either side and carries a mould, in which the teeth are

[1] For further details I must refer to the original paper in the 'Lancet' for 1867, or to a pamphlet entitled 'Cases in Surgery illustrative of a new method of applying the wire ligature in compound fractures of the lower jaw.' 2nd ed. Liverpool, 1875.

[2] 'Syst. of Surg.' 3rd ed. i. 724. From Mr. Moon's article in 'Guy's Hospital Reports,' 1873.

received. In the former plan (the interdental splint, as it is called) it may even be possible to dispense with any external support, and to confine the apparatus entirely within the mouth. The convenience of these apparatus which are moulded on to the teeth is, that they do not prevent the patient from opening his mouth, and therefore they cause no impediment to speaking or mastication, for the portions which fit on to the lower and upper teeth are hinged together inside the mouth. But they require more skill in modelling than a surgeon usually possesses, so that the services of a skilled dentist have to be called in, and great care must be taken to reduce the fracture completely under chloroform before the mould is taken. If the bone is much comminuted it may be necessary to wire, or peg, some of the fragments together inside the mould. The treatment of these complicated cases must extend over a much longer period than that of simple fracture, especially when some of the fragments become necrosed. In the celebrated case of Mr. Seward, the American statesman, who suffered from a fracture of the lower jaw complicated by a subsequent gunshot wound of the same part, the interdental splint was worn for more than a year. The reader will find all details, which space forbids me from inserting here, carefully and clearly described in a paper by Mr. Berkeley Hill in the 'Brit. Med. Journ.' for February and March 1867, and in Mr. Heath's work already referred to.



Fig. 63. Unilateral dislocation of the lower jaw. From R. W. Smith.

Dislocation of the jaw.

Dislocation of the jaw is an injury which is not very common, but which gives rise to striking symptoms, and which, when it has once occurred, is liable to recur from very slight causes. It is generally caused by a blow or fall on the chin with the mouth wide open, whereby the condyle of the jaw is driven forward; but when the jaw has once been dislocated the displacement is easily reproduced in extreme yawning, and the accident also often occurs for the first time during yawning or in convulsions. The symptoms are very characteristic. If both joints be dislocated, as is most usually the case,[1] the mouth is widely open, and cannot be closed; the chin is advanced; the saliva dribbles, partly as a consequence of increased secretion from irritation of the parotid gland, partly from deficient power of deglutition; the speech is almost unintelligible; there is a hollow just in front of the ear where the joint should be, and a prominence near the malar protuberance caused by the displaced coronoid process over which the fibres of the temporal muscle are stretched. If the dislocation is unilateral the chin is generally much twisted to the opposite side, as in the

[1] Mr. Bryant says two out of every three cases are bilateral; while Nélaton believes that the frequency of bilateral is only a little greater than that of unilateral dislocation.

annexed drawing; though this, as Mr. Hey states, is not always the case; but he points out as an infallible sign of the dislocation the hollow which is to be felt behind the dislocated condyle. Prof. Smith, in quoting these observations of Mr. Hey, says that he has seen, in a dislocation of the right condyle, the efforts at reduction applied to the left. I conclude, however, that Mr. Hey's remarks must apply to old dislocations; for if the dislocation be left unreduced (which strangely enough is sometimes the case) the patient recovers the power of closing the mouth and retaining the saliva, and to a great extent that of perfect articulation (see the fig. in Smith, op. cit. p. 289).

Reduction is generally very easy, and has been effected even as late as four months after the injury. The surgeon grasps the chin and jaw in both hands, the thumbs resting inside the mouth on the angle between the body and ramus behind the last molar teeth, while the fingers embrace the chin. The thumbs are of course protected with a cloth, or they would be severely bitten as the jaw returns to its place. The perpendicular ramus is thus forced down, whereby the condyle is disengaged from its unnatural position, while the chin is pushed back and raised; and when the condyle is thus disengaged the tense fibres of the temporal and masseter muscles will contract and replace the jaw with a snap. The process in unilateral dislocation is similar, the main point being to disengage the condyle, and then to assist the reduction by pressing the chin in the reverse direction to that in which it has been thrown by the violence. Some surgeons not caring to thrust their thumbs inside the mouth, depress the angle of the jaw by pressing on the hinder part of its ramus with two pieces of stick, or some other kind of lever, held by an assistant, and having its fulcrum against the upper teeth, while the surgeon raises the chin with his hands. Sir A. Cooper directs that the posterior teeth should be separated from each other by corks, while the chin is raised by the hands. In a case of four months' standing Mr. Pollock effected reduction by separating the jaws with wedges inserted between the molar teeth, while he drew the chin upwards by means of the strap of a tourniquet applied round the head and beneath the jaw, so that the screw might exert its power upon the dislocated bone.

Two views have prevailed as to the mechanism of this dislocation, and therefore as to the obstacles to its reduction; and I have thought it better to preface what I have to say on this point by describing the method of reduction, since the latter has considerable bearing on the question of the pathology of the injury. Nélaton, who has given great attention to this subject, and whose description of the injury is well worthy of careful study,[1] remarks on the rarity of the dislocation, and on the fact that there is very little to separate the displacement of luxation from the ordinary and natural displacement of the condyle forwards which occurs in all cases of extreme separation of the jaws, and which requires no reduction, since the bone returns spontaneously into its place. He also shows that the ligaments are so lax (in order to allow of these natural displacements) as to oppose no obstacle to reduction; and the projection of bone (eminentia articularis) in front of the glenoid cavity is also too slight to have much influence in that direction. But he says if the anterior part of the capsule be cut through on the dead subject, and the condyle of the jaw be forced through it far enough to bring the tip of the coronoid process in front of the malar prominence, then it will be found that if the coronoid process is long enough its summit will abut against the zygoma, and this will prevent any reduction until it has been forced back again. This view is supported by the preparation here reproduced from Malgaigne, by looking at which the reader

Obstacles to reduction.

[1] 'Path. Chir.' vol. ii. p. 306, ed. 1847.

will see at once that the displaced coronoid process will effectually prevent reduction; but that by pressing on the angle of the jaw from within the mouth the surgeon might easily send it back again, and so far disengage it that the fibres of the temporal muscle (which in the drawing are seen bent or twisted over the tip of the process) would become straight again, and with the masseter would easily restore the bone to its place as the chin was lifted.

But, on the other hand, Maisonneuve and Otto Weber have experimented upon the dead body, and deny that any such locking of the coronoid process against the zygomatic arch exists, at least in all cases. They would, therefore, attribute the mechanism of the dislocation to the tension of the muscles. In Nélaton's view, then, dislocation can only occur when the coronoid process is so long as to catch against the zygomatic arch; and it is to the rarity of this peculiarity of the coronoid process that Nélaton attributes the rarity of the injury; while in the other view the dislocation is caused by the muscles drawing the displaced condyle through the lacerated capsule, and fixing it there by their contraction; [1] and in support of this view the fact is mentioned that Roser was unable to reduce a dislocation of eight weeks' standing, even after cutting through both coronoid processes from within the mouth. I must refer the reader who wishes to follow the subject more minutely to Mr. Heath's work.



FIG. 64. Dislocation of the lower jaw. From Malgaigne. In this case the jaw had been often dislocated. The ligaments are entire. The condyles do not appear to have been thrown further forward than in ordinary yawning, but the coronoid processes, which are very much pushed upwards, and remarkably nearer the condyles than in the ordinary bone, ride up greatly over the malar bone, so as to lie external to the malar prominence. The patient was under Nelaton's care.—'Rev. Med. Chir.' vol. vi. p. 286.

Subluxation.

In the ordinary dislocation the interarticular cartilage remains attached to the condyle; but there is a condition described by Sir A. Cooper as subluxation, in which he says, 'the jaw appears to quit the interarticular cartilage, slipping before its edge and locking the jaw with the mouth slightly opened.' He also points out that this usually subsides of itself, but says that he has seen it persist for a length of time, and the motion of the jaw and the power of closing the mouth have still returned. If necessary, it may generally be easily reduced by drawing the jaw directly downwards and then manipulating it into place.

Somewhat allied to this is the *snapping* which Sir A. Cooper describes as felt in the joint, accompanied with some amount of pain, in young women and others of relaxed fibre, and which will subside spontaneously if the parts acquire more strength. 'Hamilton says that he frequently suffered from the affection when a youth, but as he became older the annoyance ceased without any special treatment.' Sir Astley prescribes ammonia and steel, shower-baths, and a blister.

[1] That is to say, the external pterygoid muscle would draw the condyle directly forward, while the masseter, temporal, and internal pterygoid would fix the bone against the base of the skull.

CHAPTER X.

INJURIES OF THE NECK.

Wounds of the neck. Cut-throat.

Sprains, contusions, and superficial wounds of the neck present no features which render them worthy of special description; but the wounds which lay open the deeper structures, such as the windpipe, the pharynx, and œsophagus, or the great vessels, must be studied separately; and as these wounds are most commonly suicidal, it is better to describe the usual features and the proper treatment of cut-throat. The same principles are easily applied to the somewhat rare cases in which similar injuries occur accidentally. One point which may be noticed in stab-wounds of the upper part of the neck with arterial bleeding is the impossibility in many cases of distinguishing the exact source of hæmorrhage, so numerous are the great vessels in that neighbourhood. In such cases it is justifiable to tie the common carotid, and the operation has often proved successful; but Mr. Cripps [1] has shown that it is better in most cases to apply the ligature to the external carotid, since the wounded vessel is usually a branch of the latter, and the same view has been supported by Maisonneuve, Guyon, and Fischer.

The wound in cut-throat is more commonly situated in the laryngeal than the tracheal region. This is accounted for partly by the greater prominence of that region, and partly by the easier accessibility of the air-tube there; for suicides very often think that a wound of the windpipe is necessarily fatal, and that therefore they can better accomplish their purpose by cutting through or near the thyroid cartilage. For the same reason the carotid artery usually escapes injury, since it becomes relatively deeper at that part; at least, though not really farther from the surface, it is farther from the middle line as it ascends from the level of the cricoid cartilage; and as the cut is begun not very far on the left side of the middle line, it usually fails to hit the left carotid, while the force becomes exhausted and the cut ceases before the right carotid is reached. Still, I have seen a case in which both the common carotids and both jugular veins were divided. Wounds in which the carotid artery even of one side is at all freely opened generally prove fatal before medical aid is summoned. Otherwise, the first thing, of course, is to stop all arterial bleeding, and it is not often difficult to secure the wounded vessel, for the parts have probably been freely divided and will gape widely. But the lingual artery is more commonly wounded than any other, or the superior thyroid may be divided or the facial. Having secured the arteries the surgeon must attend to the veins. They can generally be commanded by pressure with a graduated compress, but I see no danger in tying them; and as this makes them almost absolutely secure from any irregular impulse on the patient's part, it seems far better to include any considerable vein which may be bleeding freely in a ligature of carbolised catgut, or silk, with the ends cut short. The condition of the air-tube next demands attention. If it has entirely escaped, the injury (apart from the general condition of the patient) can hardly be regarded as serious; but generally it is perforated more or less extensively, as will be evident by the whistling of the air in the wound. If

[1] 'Med.-Chir. Trans.' lxi. 229.

this perforation is simple, and especially if it involves only soft parts, the knife having passed between the cartilages, it will rapidly close. But often the weapon used has been blunt, the force considerable, and the attempt repeated more than once; hence the cartilages are often hacked and fractured as well as cut. Loose portions hang down, partly obstructing respiration even at first, and any such obstruction will increase as the tissues around the loose pieces swell with œdema or inflammation. This displacement of portions is especially liable to take place when the wound has gone backwards far enough to injure the epiglottis, or when the arytænoid cartilages have been cut into. When the epiglottis is trenched upon, the wound often also lays open the mouth, and a piece of the tongue or of the floor of the mouth may fall back over the air-tube. Finally, the wound may pass through the back of the air-tube into the pharynx, or, more commonly, into the œsophagus; and the latter may even be completely severed without any large blood-vessel having been wounded.

The treatment of the simpler wounds where the windpipe is not injured is merely that of similar wounds in any other part. They may be brought together with sutures or strapping, the patient's head being drawn down towards his chest, and fixed there. For this purpose a bandage is passed round the head, and is attached, by means of two lateral strips, to another bandage going round the chest. In the first dressing of cases presenting unusual complications anæsthesia may be useful.

Sutures in cut-throat.

In cases where the windpipe is opened it is better to avoid sutures—at least, there is a traditional horror of them, and they are said to lead to erysipelas, and to produce a tendency to emphysema, and so to obstruction of the discharges from the wound and even of the breathing. How far all this is true I cannot say. Sutures are in ordinary cases unnecessary, for the edges of the wound can be kept tolerably in apposition without them; and as primary union can hardly be anticipated, there is no motive for sewing the edges together. They are therefore rarely used in such cases, and we have little experience of their alleged ill-consequences. But in complicated cases, where fragments of cartilage or portions of the tongue or mouth cannot otherwise be kept out of the air-passages, sutures must be employed to support them, and I cannot say that they seem really to do much harm.

There are cases in which the obstruction to respiration from such detached portions is so great that it is better to insert a canula into the lower portion of the windpipe through the wound, or to perform tracheotomy, after which the displaced portions can be better manipulated into position and kept in place.

In wounds of the gullet the chief anxiety of the surgeon is to get the patient to take sufficient nourishment, and yet not to interfere with the closure of the opening. I must remind the reader that the mere fact of the escape of fluid nourishment by the wound does not at all prove that the gullet is opened. The opening may be in the mouth, or there may even be no wound at all except that in the larynx. We see the same thing constantly after laryngotomy. The folds which connect the larynx to the mouth get inflamed, the larynx is no longer raised under cover of the hyoid bone, and drink runs into it and escapes by the wound. It is a distressing but not a very dangerous complication, and may be expected to disappear in a few days. Meanwhile, if the patient is thereby hindered from taking nourishment which is necessary for his life, he must be fed by the stomach-pump. If the œsophagus is wounded, and the wound is fairly within reach, it would be better, I think,

to bring its edges into appositition with one or two carbolised-gut sutures before dressing the rest of the wound, for the sutures require no removal, and will hold the parts together and allow of their speedy union; but I have not had an opportunity of trying this since the introduction of this form of suture. Any other is inapplicable; the silk from the ulceration which they cause and the silver from their tendency to irritate the parts around by their ends. Then the patient must be treated as after œsophagotomy, i.e. the wound must be disturbed as little as possible, yet the patient must be fed. It is even more necessary after suicidal than after operative wounds of the œsophagus that the patient should be well supported; and hence it is usually more advisable even from the first to pass a small tube or catheter beyond the wound (taking great care to keep it against the spine, so as not to touch the wound if it can possibly be helped), and thus to fill the stomach moderately and slowly with concentrated nutriment twice a day. Great care must be taken not to pass the tube through the wound, and especially to avoid the air-passages.[1]

In themselves all wounds of the throat which are not immediately fatal may be expected to do better, *cæteris paribus*, than those in any other region of the body, except perhaps the face. It is true that diffuse inflammation when it attacks the cellular tissue of the neck is peculiarly fatal, but it is a rare complication of these wounds in healthy subjects. The experience of Larrey, Langenbeck, Dieffenbach, and others in the extirpation of large tumours from the neck, proves that if the immediate dangers of these formidable operations are avoided, the cases do perhaps better than any others in surgery.[2] But the state both of mind and body of the unhappy victims of cut-throat is far from healthy. Many have a desire for death, which seems often to lead to its own fulfilment; others are broken down in constitution by years of intemperance; in others delirium tremens supervenes, or the wound has been inflicted during an access of delirium; and some are obstinately bent on destroying themselves, and unless closely watched will commit some renewed attempt on their lives or tear open the healing wound. Much care, therefore, is required in these cases; careful nursing, the judicious use of opium or other sedatives, and a liberal supply of nutriment in small quantities and at repeated intervals.

After-complications.

If the patient has escaped the first dangers of the wound he may yet be troubled by its remoter consequences. Of these the commonest is fistula, either communicating with the œsophagus or trachea, or sometimes leading from the one into the other. Tracheal fistula may often be closed by a plastic operation, but the fistulæ which communicate with the œsophagus are permanent, and if they are so free as to prevent the patient from taking food at all, the only thing that can be done is to feed him with the stomach-pump. He can generally learn to pass this for himself, and indeed often more dexterously than the surgeon can pass it for him; and I have seen life thus supported and the patient keep his strength and flesh apparently undiminished for nearly a year, after which he passed out of observation. In this case the œsophagus had been so freely opened that nothing could be swallowed.

[1] One of our museums contains, I believe, a preparation showing the bronchial tubes of the lungs filled with plaster of Paris, injected through a stomach-pump tube, which it was intended to pass into the stomach in a case of poisoning. Such an accident might much more readily occur in cut-throat.

[2] See 'Syst. of Surg.' 3rd ed. vol. iii. p. 886.

Another distressing complication is the loss of voice, and sometimes the growing dyspnœa which follows on the cicatrisation of the wound in the air-passage. This arises from various causes: either from narrowing of the tube in consequence of the cicatrisation which follows free (possibly complete) division of its walls, or from irregular union of wounds implicating the vocal cords, or from permanent displacement of detached portions, or from granulations springing into and obstructing the glottis. The occurrence of these irregularities in union furnishes a strong motive for uniting the wound in the larynx or trachea accurately with sutures at once whenever this is practicable, and especially when the trachea is entirely divided. The treatment of granulations obstructing the glottis will more fitly be considered in discussing the general subject of TRACHEOTOMY. Of course when it is necessary to relieve dyspnœa in any of these conditions the windpipe must be opened below, as a preliminary step in the treatment of the cause of obstruction.

Other complications, such as abscess extending down the neck,[1] inflammation running along the trachea to the lungs, or inflammatory œdema making pressure on the neighbouring parts, must be treated on general principles.

Contusions of the larynx.

Contusions of the larynx without fracture are generally produced in attempts at strangulation, or throttling. They cause temporary pain and loss of voice, but rarely lead to any further ill consequences, and require only rest and soothing applications.

Dislocation of the hyoid bone.

Dislocation of the hyoid bone from the thyroid cartilage, or more properly speaking, displacement of the former point of bone with respect to the latter, is spoken of by Gibb, in 'Path. Trans.,' vol. x. p. 67. He describes the displacement as being caused either by violence or disease, though the instances which he adduces appear to have been all spontaneous, and due to relaxation of the ligament which naturally unites the parts, and which in the instance dissected and exhibited to the Society was replaced by a pouch or capsule of new formation. The symptoms are a 'click' in the neck, the sensation of something sticking in the throat, and the appearances of displacement on examination, which, however are not clearly described. The displacement is to be reduced by throwing the head backwards and towards the side opposite to that displaced, thus relaxing the lower jaw, and if necessary manipulating the displaced bone into position.

Fracture of the hyoid bone.

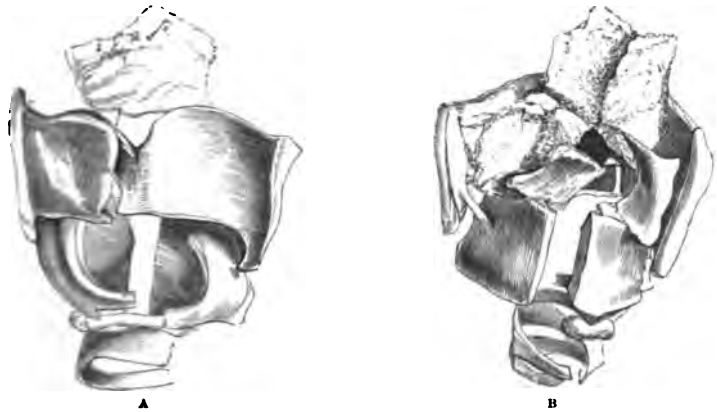
The hyoid bone and the cartilages of the larynx are occasionally though rarely fractured by direct violence, such as grasping the person by the throat, attempts at strangulation, blows, and falls on projecting objects. The hyoid bone is said to be often fractured in judicial hanging. Fracture of this bone produces great distress when the fragments are driven inwards, and especially if the mucous membrane is lacerated. All movements of the tongue, all attempts to swallow or speak, are attended with much pain and difficulty. The injury is easy to diagnose by the separation and mobility of the fragments, and crepitus may be obtained when they have been restored to position, which is generally quite easy. If there should be any difficulty an anæsthetic should be administered, the mouth fully opened and kept so by means of a gag, while the fragments are disengaged by one finger in the mouth and another externally. After reduction the parts are to be kept perfectly quiet. The patient's instinct will prevent him from talking or other voluntary movements so long as they

[1] Such abscesses sometimes pass down to the pleura, and from the external surface of that membrane the inflammation is propagated to its cavity.

are painful, and he must be fed with sops, conveyed well into the back of the mouth. In about a fortnight the parts will be so far consolidated that much of the inconvenience will have passed by, and the accident is not likely to lead to serious consequences.

Fracture of the laryngeal cartilages and trachea.

Fractures of the laryngeal cartilages or of the trachea are of more serious import than those of the hyoid bone, and when the fragments are displaced so far as to penetrate the lining membrane of the air-passages active and immediate treatment is necessary. The injury most frequently affects the thyroid, and next the cricoid cartilage. Pain and dyspnœa follow the fracture; and if the mucous membrane is lacerated there is blood-spitting, constant cough, and frequently difficulty of breathing, which may rapidly increase and end in absolute suffocation. Of course the nearer the injury is to the vocal cords, so much the more acute will be the symptoms, and so much the more decisive must be the treatment. The diagnosis is generally obvious.[1] Whether absolute crepitus will be distinguished depends in a great measure on the patient's age and the consequent extent of calcification in the cartilage.



A B

A front, and B back, view of a preparation of extensive fracture of the thyroid and cricoid cartilages taken from the body of a person who was murdered by her cook. Death resulted, in all probability, from the violence inflicted on the larynx. The hyoid bone was also fractured and comminuted, but is not shown here.—From a preparation in the Museum of St. George's Hospital.

The chief point in the treatment is, as to the necessity or advisability of tracheotomy. An interesting collection of these cases was made some time ago by Dr. Hunt,[2] from which it results that when the fragments are displaced and the mucous membrane lacerated it is always desirable to perform tracheotomy at once, since in all cases it becomes ultimately necessary; and by making an opening made at once below the seat of injury the patient is saved from the risk of sudden dyspnœa produced by an accidental displacement. When there is no evidence of such perforation the patient must be kept per-

[1] Mr. Le Gros Clark gives a useful caution in the diagnosis of these injuries: that, 'in pressing the larynx from side to side on the cervical spine, or in deglutition, the manipulator may be deceived, especially when the larynx is large, and, in elderly persons, by the peculiar sensation of roughness and inequality which is thus elicited.'

[2] Out of twenty-seven cases ten recovered, six with and four without operation. Only two patients died out of eight in whom tracheotomy was performed, while out of nineteen who were not operated on fifteen died; and in no case where emphysema and bloody expectoration testified to perforation of the mucous membrane by the fragments did recovery take place without tracheotomy.—'Am. Jour. Med. Sc.,' April 1866. A larger collection of cases has been given by Mr. Durham ('Syst. of Surg.' 3rd ed. i. 749) of which fifty-three proved fatal, and it is noteworthy that all the cases (28) in which the cricoid cartilage was fractured, whether alone or along with other cartilages, died.

fectly quiet, and the case must be watched with a view to tracheotomy if necessary.

Complete rupture of trachea.

Sometimes the injury has been known to involve the complete subcutaneous rupture of the trachea,[1] so that there is a large depression in the neck where the trachea should be, and the patient breathes with great difficulty by the indirect passage of air from the upper part of the windpipe through the interval, which must be partly occupied with blood, and so into the retracted lower end of the trachea. Under such circumstances not a moment should be lost in attempting to find the lower end of the trachea and fixing it by introducing a tube. The parts are to be very freely divided in the median line, and the trachea drawn up to the surface. If it is very movable and retracts easily there is no objection that I can see to fixing it temporarily with a suture.

Foreign bodies in the air-passages.

The entrance of a foreign body into the air-passages is a formidable accident, and one which not unfrequently proves fatal. It may occur at any period of life, but is more frequent in children, both from their natural want of caution and experience, and from their frequent habit of playing with things in their mouth. The accident is caused by a sudden inhalation while holding something in the mouth, as by laughing or gasping with fright while taking food, by catching a coin in the open mouth, &c.; and in some rarer cases the foreign body has been driven in from the outside, as in the case of a child who was cracking a whip in the lash of which a large copper pin had been fixed. The pin got loose, and passed through the trachea. Fortunately the surgeon recognised the small puncture, and cut down on the foreign body.[2] And I think there can be no doubt that, although in swallowing the larynx is usually so drawn up that no foreign substance can pass into it, yet occasionally a pointed body (such as a piece of bone) may hitch under the epiglottis and pass into the upper part of the larynx, in swallowing, without an inhalation.[3]

Another comparatively frequent accident is the impaction of a large mass of food in the pharynx obstructing the upper opening of the larynx, and causing speedy death if not dislodged. The treatment is simple, if the nature of the case be recognised in time. The mass being pushed down or hooked up, the breathing may be at once restored; if not, artificial respiration is to be sedulously practised.

Foreign bodies which have passed fairly into the windpipe may be lodged in various situations. They may be detained above the rima glottidis, and then may be thrust more or less completely into the ventricle of the larynx; they may be caught between the vocal cords; may stick in the cavity of the larynx; may lie either fixed or, more commonly, loose in the trachea; or may

[1] See Mr. Halford's case, in 'Syst. of Surg.' 3rd ed. vol. i. p. 751.

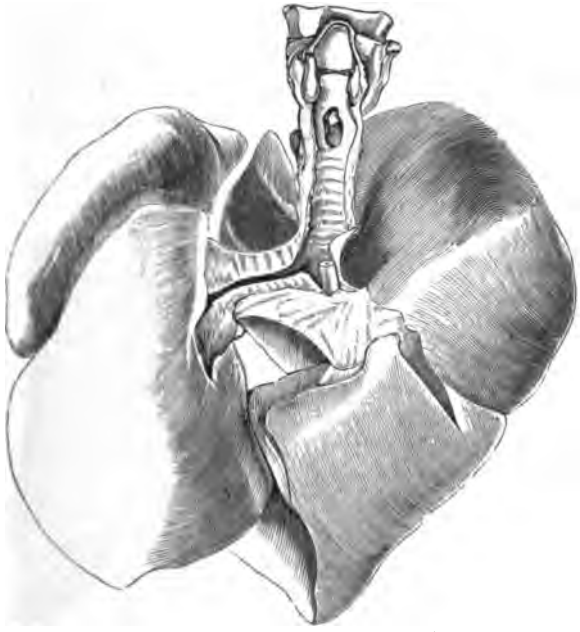
[2] De la Martinière, 'Mém. de l'Acad. de Chir.' v. 521.

[3] This was the case with a little child under my care some years ago, in whom a large piece of the bone of a rabbit was lodged in the upper orifice of the larynx, exciting great dyspnœa, and having set up extensive tracheitis and bronchitis extending through both lungs. It was extracted through the mouth about thirty-six hours after the accident. The bone was too large and too irregular to have been easily inhaled, and the mother said the child took the spoonful of food quite quietly and choked immediately afterwards. From the position and shape of the bone there could be no doubt that a large prong of it was sticking through the glottis and irritating the air-tube. In another case under my care an adult got a large piece of rabbit bone into the upper part of the larynx in consequence of laughing whilst he was eating soup. The bone lodged above the glottis and had to be removed by thyrotomy.

pass down beyond the bifurcation of the trachea into one of the bronchi, or even lower, into one of the bronchial tubes of the lung itself.[1]

The symptoms vary partly with the size and shape of the foreign body, partly with its position. The larger and rougher the foreign body is, the more acute will probably be the symptoms; the nearer it is lodged to the vocal cords, the more spasm is it likely to cause; the more firmly it is impacted in one of the bronchi, the more complete is the loss of breathing on one side.

In their most marked form the symptoms of a foreign body in the air-passages are as follows: The patient, being previously in his usual health, has been



64. From a preparation (Ser. vii. No. 79A, in St. George's Hospital Museum), showing a piece of tobacco-pipe impacted in the right bronchus of a child. The symptoms were very obscure, perhaps because the air passed through the pipe into the lung.[2] Ultimately tracheotomy was performed, but the foreign body could not be reached. *Mem.* The lungs and bronchi have been somewhat displaced in making the preparation, so that the right bronchus looks much more perpendicular than it is.

suddenly seized with convulsive cough and dyspnœa, aggravated into severe paroxysms. At the same time it is possible that he or, if a child, his parents,

[1] 'Out of twenty-one cases analysed by Professor Gross, in which death took place without operation, and without expulsion of the foreign body, in four the foreign substance was located in the larynx; in one, partly in the trachea, partly in the larynx; in three, in the trachea; in eleven, in the right bronchial tube; in one, in the lung; in one, in the right pleural cavity.

Out of forty-two cases subjected to operation or general treatment the extraneous substance was situated twice positively, and eleven times probably, in the right bronchial tube; seven times certainly, and four times probably, in the left bronchial tube; seven times in the trachea, and fourteen in the larynx. Out of fifty-seven cases occurring during the last few years, of which I have notes, in twenty-seven the foreign body was in the larynx; in eleven, in the trachea; in ten, in the right bronchus; and in nine, in the left bronchus. It would thus appear that the larynx and the right bronchial tube are the most frequent situations in which foreign substances are arrested. This conclusion, however, does not precisely coincide with that derived by M. Bourdillat from the analysis of 156 cases. In eighty of these the foreign body was in the trachea; in thirty-five, in the larynx; in twenty-six, in the right bronchus; and in fifteen, in the left bronchus.'—Durham, in 'Syst. of Surg.' 3rd ed. vol. i. p. 758.

[2] The same was the case in a patient under Mr. Hulke's care ('Med.-Chir. Trans.' vol. xl. p. 91), in whom a tracheotomy tube had slipped into the bronchus.

may know that he has swallowed something, or that something which was in his mouth has disappeared. The speech will be more or less affected and the breathing whistling or stridulous. There may be some pain about the part where the body is lodged (probably about the thyroid cartilage), aggravated by pressure. The foreign body can in some cases be felt by exploration from the mouth,[1] and in others can be seen by the laryngoscope. More rarely it can be felt in the neck.

Diagnosis of the lodgment of a foreign body.

The diagnosis in cases where a foreign body is not perceptible and the history is not clear (which is very commonly the case in childhood) is by no means easy. It rests mainly on the sudden accession of the symptoms during a condition of complete health, and is therefore easier the sooner after the supposed accident the patient is seen. In case the history should be doubtful the diagnosis between the irritation produced by a foreign body and the dyspnœa of croup or laryngitis rests in a great measure upon the comparative absence of fever in the former case, the patient being sometimes almost well during the intervals between the spasms. In some cases, where the foreign body moves about in the trachea, the patient is himself quite conscious of its movements. When it has dropped into one of the bronchi the entrance of air into that lung is prevented, either totally or in great part, and therefore there is absence of the respiratory murmur and of the dilatation of the lung, without dulness to percussion or any other sign of pleurisy or pneumonia. In some cases a whistling and cooing rhonchus has been heard at the point where the foreign body is lodged.[2]



FIG. 67. Bifurcation of the trachea, seen from behind, showing the septum to the left of the median line, and showing also the more vertical direction of the left bronchus. – From Durham, 'Syst. of Surg.' 3rd ed. vol. i. p. 759.

The right bronchus is rather more commonly the seat of lodgment than the left, since the septum is placed somewhat to the left, though the more horizontal direction of the right bronchus to some extent neutralises this tendency. (See the foot-note on the previous page.)

In cases where a perfectly confident diagnosis cannot be made, yet there seems good reason for thinking that there may be a foreign body in the windpipe, it is better to treat the patient as though this were the case, since an opening may relieve dyspnœa from other causes, and the operation does not add very much to the patient's danger.[3]

[1] Such an exploration should never be neglected, unless the symptoms are so urgent as to render the instantaneous opening of the windpipe a matter of necessity. Under chloroform the finger can be passed into the upper part of the larynx easily in a child, and usually can be got beyond the epiglottis in an adult.

[2] Le Gros Clark, op. cit. p. 237. This symptom was very plainly marked in a case under my care where a small piece of apple was lodged near the bifurcation of the trachea.

[3] Mr. Barwell gives references to seven cases in which the foreign body was not found at the operation, yet the patients recovered; probably from the unnoticed escape of the substance.—'Clin. Soc. Trans.' vol. vi. p. 120.

When the diagnosis of a foreign body has been made the surgeon should allow no delay in removing it at once. It is true that substances have remained for years in the trachea innocuous; but it is far more probable that a foreign body which may be setting up no very marked symptoms at the moment will afterwards get displaced and cause urgent, perhaps fatal, dyspnœa when there is no help at hand. Treatment.

There are cases in which the foreign body can be seen with the laryngoscope and extracted by means of forceps introduced by the mouth; but these are rare. A case is recorded[1] in which a brass ring had been lodged near the upper opening of the larynx for four years. The patient was a child 6½ years old, and was then suffering from aphonia and laryngeal spasms. The position of the ring is thus described: 'It encircled the left arytænoepiglottidean fold and ventricular band; but, except where it passed deeply into the tissues, it did not come into contact with the larynx.' It should be remarked that the ring had a fissure at one part. Extraction by the help of the laryngoscope being found impossible, on account of the child's indocility, the foreign body was successfully removed by making a transverse incision through the thyro-hyoid membrane, drawing the epiglottis with the cushion of fat and cellular tissue at its base, downwards, and thus penetrating between the hyoid bone and epiglottis into the space above the glottis. To this operation the operator gives the name of 'subhyoidean laryngotomy,' and it is a proceeding which in rare cases may prove useful; but in general foreign bodies lodged in this situation can be extracted with forceps of appropriate shape from the mouth when the patient is fully narcotised.

If the symptoms are not very urgent (in which case the windpipe must be opened without a moment's delay) chloroform should be given; and unless the position of the foreign body is known the first step is to examine the parts as far as the finger can reach. If it cannot be extracted from the mouth, but appears to be lodged near the glottis, the cricothyroid membrane, cricoid cartilage, and in children one or two rings of the trachea, should be divided, so as to have a very free opening. Possibly the body may now be removed or may shoot out of the wound; otherwise the larynx must be examined with a large instrument, such as a female catheter,[2] and the substance pushed up through the glottis or extracted with forceps. If this cannot be done, yet the substance can be felt lodged just above the glottis, a canula should be placed in the lower part of the wound,[3] the two alæ of the thyroid cartilage cautiously divided, and the foreign body picked out of the ventricle of the larynx. When the body is loose in the trachea a free opening low down will generally procure its exit.[4] When in one of the bronchi all that can be done is to open the trachea as low down as is prudent, and by a very free incision. Then, if the situation of the foreign body can be ascertained by probing, it may be possible to extract it with forceps or to dislodge it with a hook; or the patient's body being inverted and shaken, the foreign substance may be discharged either from the glottis or from the wound.

Sir B. Brodie's celebrated case[5] of Sir I. Brunel, in which a half-sovereign

[1] 'London Med. Record,' April 14, 1875.

[2] Mr. Durham recommends the ivory top of a gum catheter.

[3] The operation is much facilitated by having the trachea plugged by means of Trendelenburg's or Semon's tampon, so that no blood can run down the windpipe.—See a paper by [illegible] in 'Med.-Chir. Trans.' vol. lxv.

[4] Mr. Hilton is in favour of making this opening transversely valvular.—'Med. Times and Gaz.' vol. i. 1867, p. 507.

[5] 'Med.-Chir. Trans.' vol. xxvi. p. 286.

had dropped into the right bronchus, shows the advantage in these cases of making an opening in the trachea, even if the foreign body is not extracted from it. The inversion of the body, which before produced great dyspnœa from the coin striking on the glottis, became perfectly tolerable afterwards, and the coin dropped quietly into the mouth. The same case shows also the great difficulty which may be met with in exploring the trachea with forceps or other instruments. The walls of the air-tube are so very irritable that any contact of the instrument is sure to provoke spasmodic cough, and the instrument is as likely to poke the foreign body further down as to bring it up, besides the risk of catching the 'bifurcation of the trachea, or one of the subdivisions of the bronchus, instead of the foreign body.' So that it is better, after having made a free opening in the trachea, to try and dislodge the foreign body by changes of position, by inversion of the body, by shaking or slapping the chest rather than to risk the evil consequences which may follow the introduction of instruments; and if such introduction becomes necessary, to try rather to displace the body by getting a hook, wire-snare,[1] or bent probe below it than to catch it with the forceps. At the same time, as the forceps have no doubt been used successfully in such cases,[2] the attempt ought to be made when the circumstances call for it.

Mr. Durham says: 'Dr. H. B. Sands[3] has pointed out that "in adults the bifurcation of the trachea and the orifice of each primary bronchus can be reached by the forefinger introduced through an ordinary tracheotomy wound; and that when desirable the little finger can be passed upwards into the larynx, so as to detect either a foreign body or a morbid growth." This fact may be readily verified on the cadaver, and its practical value is very great, as was well illustrated in a case under the care of Dr. Gordon Buck, in which Dr. Sands readily felt and determined the exact position of a hard india-rubber tracheotomy tube which had fallen into the trachea and become impacted in the right bronchus. The tube having been felt was easily extracted.'

Foreign bodies may also be successfully treated in some cases by inversion of the body and succussion without any previous operation. In many cases the substance has become loose and has fallen through the glottis, and the plan is well worth trying, particularly in cases where the body is smooth and heavy; but as there is a risk that the substance, if dislodged, may be caught by the spasmodic closure of the vocal cords, and instant suffocation be thus produced, it is well before resorting to this plan to be prepared for laryngotomy in case of any such emergency.

After-consequences of lodged foreign body.

The after-consequences of the lodgment of a foreign body, if it be not extracted, are very various. They vary as the immediate symptoms do, with the position, size, shape, and smoothness of the substance. Pointed rough substances, wherever they may be impacted, produce a rapidly-spreading inflammation of the internal membrane of the air-passages, spreading down the trachea into the smallest bronchial tubes. Thus, in the first case referred to on

[1] Mr. Hulke recommends especially a hook made out of a long piece of stout German-silver wire.– 'Med.-Chir. Trans.' vol. lx. p. 91.

[2] Liston succeeded in extracting a piece of bone from a point below the right sterno-clavicular joint with forceps; and Dickin, of Middleton, near Manchester, extracted a button which had lodged in and completely obstructed the right bronchus, producing the most characteristic signs of total suppression of breathing on the right side. The latter case is the more remarkable, since the opening was made between the cricoid and thyroid cartilages, and therefore the wound was farther than necessary from the foreign body (see South's 'Chelius,' vol. ii. p. 402, or Liston's 'Practical Surgery,' pp. 415–420).

[3] 'American Clinical Lectures,' vol. ii. p. 199. Putman, New York, 1876.

page 186, *note* 3, a pointed thorn of bone, sticking through the glottis into the larynx, produced in the course of a day bronchial effusion over both lungs. On the other hand, a smooth body (like Sir I. Brunel's half-sovereign) may remain impacted in the lower part of the trachea, in one of the bronchi, or even in a large bronchial tube of the lung itself, for a considerable period without exciting any such symptoms. Nor are cases wanting to prove the possibility of a smooth foreign substance becoming encysted or encased by inspissated mucus and remaining perfectly innocuous.[1] But such cases are exceptional, and ought not to deter the surgeon from the necessary operation in any case in which he has certain evidence of the lodgment of a foreign body. The case far more commonly proves fatal, and death is produced in various ways. The rougher substances cause acute inflammation, as above stated, paroxysms of cough proving fatal either by loading of the lungs or spasm of the glottis. In some cases a body which has long lain quiet changes its position, irritates the vocal cords, and so produces spasm of the glottis. In many cases in which a smooth body has been lodged in the deeper parts of the tube it has ulcerated into the lungs and produced all the symptoms of phthisis;[2] so that Sir B. Brodie says: 'The records of surgery furnish abundant evidence that under such circumstances, disease of the lungs sooner or later is induced, and that the death of the patient invariably ensues.' And even when the body is lodged higher up, in the larynx or upper part of the trachea, there is good reason to apprehend that it will set up ulceration at the seat of its lodgment, and that disease of the lungs will follow. This is strikingly illustrated by a case reported by South (op. cit. p. 896), in which a child died six weeks after the lodgment of a pebble in the larynx. The nature of the case was mistaken, and the severe paroxysms of cough attributed to pertussis. The cricoid cartilage in which the stone was lodged was laid bare by ulceration, and both lungs were extensively hepatised, while one pleura was filled with turbid serum.

Burn and scald of the larynx.

The implication of the larynx in a burn or scald is a very grievous and dangerous complication of such an injury, and one which unluckily is by no means rare. The parts below the glottis are protected by the spasmodic closure of the vocal cords at the moment of the accident, but great œdema of the mucous lining of the fauces, epiglottis, and orifice of the larynx comes on, with fits of spasmodic dyspnœa, which are always exceedingly alarming and not unfrequently fatal; the voice is hoarse, the respiration croupy, and the mouth probably so much injured that the patient (especially if a child) can hardly be got to take food. The accident is more frequent in childhood, and is often caused in very young children by sucking the spout of the kettle. The great danger is from the spasms, and the prognosis depends mainly on their severity and frequency; but even after surviving this danger the patient may still sink from bronchitis or broncho-pneumonia, the result of inflammation spreading downwards.

In such cases the first point is that the patient must never be left until all immediate danger is over, since the spasms come on quite irregularly and with

[1] Sir T. Watson relates a case in which a piece of gold remained for years in one of the ventricles of the larynx without distressing consequences; and there are other cases recorded in which a foreign body has become glued to the wall of the trachea, or has ulcerated into the substance and thus become encysted.

[2] Characteristic cases, which want of space forbids me to introduce, will be found in 'Celsus Chelius,' vol. ii. p. 397.

little warning.[1] Leeches should be freely applied to the throat, and frequent small doses of calomel and antimony, or antimony and aconite, given. The dose must of course vary in proportion to the age. Mr. Durham prescribes one or two minims of vin. ant. with a quarter or half minim of tinct. aconit., at first every quarter of an hour, then every half-hour, and then at longer intervals. Possibly the cautious administration of chloroform will relieve the spasms, and then the mouth can be fully opened and the œdematous parts around the fauces freely sacrificed. Finally, in the last resort, laryngotomy or tracheotomy must be performed; but my experience of these cases has been that those which are so severe as to demand operation generally die, and that it is better if possible to refrain from opening the windpipe, remembering that even very alarming spasm seldom proves fatal.[2] Some surgeons prefer the operation of tracheotomy to that of laryngotomy in these cases, in order to get farther from the injured parts; but as the œdema is always limited to the tissue above the vocal cords, the operation of laryngotomy is sufficient. In very early life, however, the size of the cricothyroid space is not sufficient to allow a free opening, and then laryngotracheotomy must be performed. Much benefit is obtained in the treatment of the broncho-pneumonia which accompanies these and other injuries of the windpipe from the use of the 'jacket-poultice.'

Cases occur in which the larynx is injured by corrosive fluids; these must be treated on the same principles.

The operative procedures for opening various parts of the air-passage, and the indications for each of them, will be found in a future chapter, under the head of DISEASES OF THE LARYNX.

Foreign bodies in the œsophagus.

Nothing is more common than for a patient to imagine that he (or she) has got some foreign substance lodged in the pharynx or œsophagus, when no such thing is really the case. Something sharp has been swallowed with the food, such as a sharp edge of bone, and the sensation of the scratch remains after the substance itself has passed away, and, indeed, may remain for a considerable time, rendering deglutition painful and difficult. At the same time cases occur pretty frequently in which a pin or a small bone or bristle has been hidden behind the arches of the fauces and has escaped a hasty examination; so that all such cases should be patiently and completely investigated, and in doubtful cases the laryngoscope will be very useful, though the examination can of course only extend to the fauces and upper part of the pharynx.[3] Large foreign bodies are generally arrested in the œsophagus opposite the cricoid cartilage, but they may pass lower. I have spoken above of those

[1] Mr. Bryant speaks of a case 'in which the symptoms were so slight that no anxiety was felt; but one spasm took place 2½ hours after the accident, which put an end to life.' ('Practice of Surgery,' 2nd ed. vol. ii. p. 24.) This is a striking instance of the necessity of constant watchfulness and preparation for instant operation in these as in all other cases in which spasm of the glottis appears imminent.

[2] I would refer the reader to a striking case related by Mr. Le Gros Clark (op. cit. p. 230), in which the symptoms were so acute that, 'though not entertaining a favourable opinion of tracheotomy,' he thought it his duty to offer the alternative to the child's parents, who, however, declined the operation; and the patient ultimately struggled through. Mr. Le Gros Clark's remarks on the advisability of avoiding tracheotomy as much as possible quite coincide with the view stated in the text.

[3] A very interesting case is recorded by Dr. Fruitnight of New York in the 'N. Y. Arch. of Clin. Surg.' vol. i. p. 335, where a pin, which had been impacted for three weeks in the posterior nares, and was giving the patient great inconvenience, was detected and removed by means of the laryngoscope.

cases in which a voluminous mass rests above the pharyngeal opening of the larynx and must be displaced, or instant death results. But in cases of foreign bodies lodged in the œsophagus there is no such urgent danger. The impaction, however, of a solid body is inconsistent with prolonged life, since it prevents deglutition either by mechanically filling the gullet or by the pain which it produces when it sticks into the walls of the tube, as a pin or a sharp bone sometimes does. The nature, size, and shape of these foreign bodies are very various. A toothplate carrying one or two artificial teeth not unfrequently drops into the mouth and is swallowed during sleep; a coin swallowed intentionally; a ragged piece of bone; a pin or piece of wire or a fishbone, are familiar instances. Some obstruct the gullet entirely, others partially; some are organic and soluble, others metallic and insoluble; some have smooth edges, others are jagged or sharp. The first point is to ascertain as nearly as may be what the size and shape of the substance is and where it is lodged, in order to settle the important question whether it can be pushed down into the stomach or fished up from the mouth. A smooth metallic body deeply lodged is best dealt with by gently pushing it down into the stomach with a probang having a sponge at the end; and even somewhat rough bodies may be successfully treated this way, though the practice is not

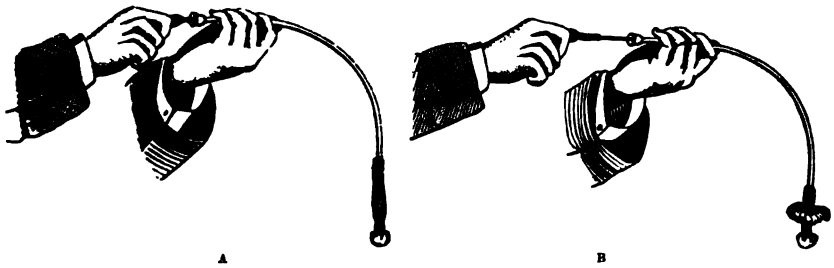


Fig. 68. The horsehair probang for extracting foreign bodies from the œsophagus, such as coins, bones, &c., which are lodged in, but do not entirely obstruct, the tube. The instrument contains a skein of horsehair inserted near its extremity, which is dilated by pulling its handle out. It is introduced, as seen in fig. A, with the skein closed, past the foreign substance. Then the handle is pulled out (fig. B) and the instrument withdrawn with the skein opened, in order that the horsehair may catch and bring away, or at least dislodge, the foreign body.

without its dangers.[1] If more superficially lodged it may possibly be extracted with the long œsophagus-forceps, which must, however, be very gently managed, in order to avoid injury to the coats of the œsophagus. Coins can often be dislodged and fished up by a blunt hook at the end of a probang. The situation of the coin having been ascertained by means of a long probe or a urethra-sound, the hook is pushed beyond it, and turned round towards the coin, and withdrawn. Pins, small bones, &c., may be caught in the horsehair probang here figured.

Pieces of meat and bone have been known to be so far disorganised and softened by the constant use of dilute mineral acid as to be at length swallowed. Vomiting has sometimes been successful in dislodging foreign substances. It is dangerous to the integrity of the œsophagus; but when a large and

[1] Mr. Pollock, in the 'Lancet,' 1869, vol. i. pp. 456–490, records two cases in which a toothplate slipped into the œsophagus. In one, where the plate was small, carrying only two teeth, but with very sharp edges, the patient seemed to be in danger of sinking from want of food, the plate being lodged near the stomach, whence it was somewhat dislodged by means of an œsophagus-tube, and then it passed into the stomach, on the nineteenth day after the accident. Here it remained for ninety-seven days, and was then ejected by vomiting. In the other case a much larger plate, but with much smoother edges, passed through the whole alimentary canal, and was expelled in defæcation in three days.

tolerably smooth foreign body is lying in the stomach and cannot pass the pylorus, it is probably best, as Mr. Pollock directs, to attempt its removal by inducing vomiting after a full meal, so that the foreign substance may be rejected along with the mass of food.

Esophagotomy.

Finally, there remain a few cases where the surgeon thinks it his duty to cut down on the foreign body and remove it at once.

This operation is most easily performed on the left side, in consequence of the inclination of the œsophagus to that side, but the shape of the substance may render it necessary to cut down from the right. It consists essentially in making an incision between the carotid sheath and the larynx or trachea, drawing the latter tube inwards, while the vessels are displaced outwards, and seeking for the foreign substance through the wall of the œsophagus, which is now exposed. The incision and the early steps of the operation are much the same as for ligature of the carotid. The centre of the incision should be about opposite the cricoid cartilage. If it be too high the superior-laryngeal nerve will be endangered; if too low, the inferior thyroid artery. When the foreign body is too small to be perceptible externally, its situation and the position of the œsophagus are to be fixed by passing a staff or catheter down the tube. When the surgeon has felt the foreign body he divides the œsophagus longitudinally, just enough to enable him to catch it and draw it into the wound; it must then be freed from the fibres of the œsophagus as gently and with as small an opening as possible. No sutures have hitherto been used to close the wound in the œsophagus, but it seems probable that one or two fine catgut sutures might hasten its closure, and melt without producing any ulceration.

Some surgeons feed the patient by the rectum for a few days after the operation, but Mr. Cock thinks it better to pass a small tube or elastic catheter beyond the wound, and let the patient have food in the stomach from a very early period after the opening.

Foreign bodies have been extracted from a part of the œsophagus much lower than can be reached by the incision. Thus Mr. Syme removed a foreign body lodged just opposite the top of the sternum, and Dr. Cheever one which was fixed below the sternum.[1]

The operation has hitherto proved very successful. Forty-five cases are referred to in Mr. Durham's essay on injuries of the neck in the third edition of the 'System of Surgery,' of which only nine proved fatal; and it seems undeniable that in some, at any rate, of these latter, a more speedy performance of the operation would have given the patient a better chance; for in one case (Arnott's), where the operation was not allowed until five weeks after the accident, the patient died of pneumonia, which had been developed previously; in four cases abscess had already formed; and in another (Martini's), where sixty attempts had been made to dislodge the foreign body (which was, in fact, swallowed during the operation), the pharynx was found to be gangrenous. Hence the propriety of the rule laid down by Mr. Arnott[2] is now generally recognised: that, 'when a solid substance, though only of moderate size and irregular shape, has become fixed at the commencement of the œsophagus or low down in the pharynx, and has resisted a fair trial for its extraction or displacement, its removal should *at once* be effected by incision, although no urgent symptoms may be present.'

[1] Cheever 'On two cases of Œsophagotomy.' Boston, U.S., 1868.

[2] His interesting paper in the eighteenth volume of the 'Med.-Chir. Trans. relating to the first case of œsophagotomy performed in this country, is well worthy of study.

In several cases, where the foreign body has not produced complete inability to swallow, it has nevertheless occasioned death by ulceration into the aorta or into the spinal column, pleura, or other parts. In one case even the heart was perforated.[1]

Injuries to the œsophagus by the passage of foreign bodies, or by swallowing corrosive liquids, will sometimes produce a severe form of cicatricial stricture; but on this subject, and on the subject of gastrotomy, or opening the stomach in order to remove a foreign body, or to obviate starvation in stricture of the œsophagus, I must refer the reader to a future chapter in which the latter subject is treated.

Œsophagostomy.

In a case of stricture of the œsophagus from epithelioma, limited to the parts around the thyroid cartilage and thyroid bone, I performed the operation of œsophagostomy,[2] i.e. made a permanent opening in the œsophagus, and introduced a tube through which food could be passed into the stomach. The operation did no good, as the patient, who was much exhausted, sank in three days; but it was equally harmless. It proved, however, one of considerable difficulty. Further experience is needed to show whether this operation is ever preferable to gastrostomy, and, if so, in what cases it should be used.

The subject will be resumed in speaking of stricture of the œsophagus.

[1] See Durham, in 'Syst. of Surg.' 3rd ed. vol. i. p. 787.

[2] 'Med. Times and Gaz.' July 29, 1882.

CHAPTER XI.

INJURIES OF THE CHEST.

In describing the injuries of the chest, the pleura is always taken as the boundary between its parietes and its contents, so that wounds are classified as penetrating or non-penetrating, according as they do, or do not, open the pleural cavity. At the same time it must be recollected that the pleura, or any of the thoracic viscera or vessels, or even the viscera of the abdomen, may be injured in contusions and in non-penetrating wounds by fragments of fractured ribs, and also that (though in very rare cases) the lungs or heart may be lacerated in contusions not involving any fracture of the ribs.

Contusions and flesh-wounds.

There is little that is peculiar to the region of the body in contusions or flesh-wounds of the chest. It may, however, be worth mention that the pectoral muscle is sometimes ruptured in severe sprains or other injuries in

Rupture of muscles.

which the patient's arm is violently jerked while his body is in rapid motion in the other direction (as when in a fall a man grasps at a bar). The injury may be known at once, by the great gap which is found in the front wall of the axilla, and the loss of the functions of the muscle. Sometimes also large extravasations or blood-tumours are formed under the pectoral muscle, which can only be distinguished from subpectoral abscess by their rapid formation, and the absence of any inflammatory symptoms or appearances.

The treatment, however, of these complications differs in no respect from that of ruptured muscle, or of hæmatoma, in other parts of the body.

Sub-pectoral abscess.

Abscess beneath the pectoral muscle is met with as the result of injury, and also forms spontaneously. The main point is to diagnose it from deep-seated hæmatoma and from rapidly forming cancer. The œdematous infiltration and inflammation of the surrounding cellular tissue, and the clearness of the fluctuation, are the main features which distinguish it from both, and in case of need the grooved needle will settle the question. A free and deep incision is necessary, and this is best made under anæsthesia, especially as large vessels may be divided. It is usually recommended to make the incision across the fibres of the muscle, a recommendation from which I venture to dissent. Quite as satisfactory exit for the matter may be procured by an incision running between the fibres, provided it be free enough; for which purpose, when the matter is reached, the incision may be dilated with the finger; and a large tent of lint should be kept in for the first three or four days.

Fracture of the ribs.

Fracture of the ribs is a very common accident, and occurs either as the result of direct violence, in which case usually only one or two ribs are broken, or of indirect force from compression of the thorax by a crush either from the back or front, when a good many ribs give way at or near their angles and sometimes on both sides of the chest. A rib may also be fractured by muscular action in coughing—an occurrence which is somewhat ominous of the presence of disease in the fractured rib, but has been known to occur without any evidence of such disease. The broken ends of the ribs may be driven into the pleura, the lung, the diaphragm, and even through the diaphragm into the liver or spleen; but the last-named lesions are very rare, and are usually only found in extensive and necessarily fatal injuries. It will

be sufficient for practical purposes to discuss merely fractures of the ribs; (1) uncomplicated, and (2) complicated with injury to the lung.

Simple uncomplicated fracture of one or two ribs is a very trivial accident, hardly ever followed by any grave consequences if properly treated. But the danger increases considerably when many ribs are broken, and particularly on both sides. I have seen, however, a young woman recover from an accident in which, as far as could be ascertained, every rib in the body was broken and extensive injury inflicted on the brachial plexus of one side. The first and (though to a less extent) the second ribs are not so liable to fracture as those below them, the projection of the clavicle and the mass of the pectoral muscle shielding them from injury; and the floating ribs by their extreme mobility also more commonly escape fracture. Fracture of the upper ribs is looked upon as a more serious injury than of the lower, since the lung is more often wounded. The posterior part of the ribs is less exposed to fracture than the middle, being under the protection of the thick muscles of the spine. The ribs do, however, give way sometimes near their tubercles, and the injury is difficult of diagnosis; sometimes discovered after death in cases where it has not been possible to form a distinct diagnosis during life. The signs of fracture of the ribs are pain at the part, aggravated by deep breathing or coughing, and crepitus. The breathing is often very shallow, and there is short hacking cough.[1] Emphysema of the cellular tissue can only occur if the fragment has penetrated the lung, and is decisive of the nature of the injury without further examination. It is not by any means always easy to detect the crepitus of a fractured rib. The periosteum is often untorn,[2] and then it is difficult to produce sufficient movement of the fragments on each other, or they may perhaps be interlocked, though we can hardly conceive them to be absolutely impacted. At any rate, it is certain that in many cases where we have every reason to believe fracture to have occurred it is not possible to elicit crepitus. The best plan is to lay the hand flat on the suspected part and get the patient to breathe deeply or cough, if it does not give too much pain. If this does not succeed, each rib may be traced, and manipulated at either side of the supposed fracture like any other bone, care being taken not to handle portions of two different ribs, as unskilful or careless persons sometimes do. Auscultation is recommended, but I cannot say that it seems to me of any use. I have heard the crepitus of an undoubted fracture through the stethoscope, but never succeeded in thus hearing a crepitus that I could not feel. It is, however, only right to add that other surgeons have a higher opinion of the diagnostic value of auscultation.[3]

The union of fractures of the ribs takes place, it is said, in about thirty to thirty-five days, but I believe that this is very variable, and that the time required for union is often much longer. I have felt crepitus a fortnight after the injury as fresh and distinct as at the time of its infliction. And the impossibility of keeping the fragments at rest causes fractures of the rib to unite by provisional callus more frequently than those of any other bone in the human subject. In fact, excluding some very exceptional cases (like that

[1] Mr. Le Gros Clark conjectures that these symptoms are sometimes the result of injury to or pressure on the intercostal nerve by the broken bone.

[2] M. Coulon cites, in his 'Traité des Fractures chez les Enfants,' p. 90, a case published in the 'Bull. de la Soc. de Chir.' 2nde sér. tom. i. p. 675, of a child who died of rupture of the lung, and in whom incomplete fractures of two or three ribs were found on both sides. This author believes incomplete fracture of the ribs to be very common in childhood.

[3] See Lyell, in 'Syst. of Surg.' 3rd ed. vol. i. p. 808.

represented in fig. 35), all the instances of regular ensheathing callus in the human subject are taken from fractures of the ribs (see fig. 34, p. 121). In some cases the adjacent ribs when broken become fused together, as in a specimen figured in the 'System of Surgery,' 3rd. ed. vol. i. p. 809, and others in Hamilton's work.

The treatment consists in avoiding the movements of respiration as much as is compatible with the patient's comfort. Confinement to bed is necessary only in the severer cases, but all active exertion should be forbidden. A bandage to the chest usually affords great relief. It should be applied around the whole thorax, as low as the end of the sternum, and should be commenced when the patient has emptied the chest as much as possible; the roller should be six inches broad, and should be adapted to the varying size of the chest by reverses where necessary. When the bandage is finished a piece long enough to go across the chest should be left hanging, being secured by a pin or tacking; this should be split half-way down and the two ends brought over the shoulders and fastened on the other side like a pair of braces, in order to keep the bandage from slipping down; or a piece of this kind should be sewn on. Another plan is to fix the injured side only of the chest by broad pieces of strapping applied from the spine to the sternum. This is thought to embarrass the breathing less, but it does not seem to me to give such efficient relief. Sometimes a mere belt is applied round the injured part fixed with buckles.

The bandage is to be worn till the patient can dispense with it with comfort, say for a month. When any noticeable displacement is felt, in consequence of one end lying below the other, an attempt may be made to repress it by placing a pad on the projecting part of the rib which is driven in, so as to prise outwards its buried end.

Fracture with wound of lung.

When the lung is injured the complication is at once marked by the resulting emphysema. The fractured end of the rib or ribs must be driven through the pleural cavity into the lung, an occurrence much more likely to take place in fracture from direct violence, when the bone is driven directly downwards, than in that from indirect force, when (the curve of the bones being increased) the tendency is for the ends to spring outwards;[1] the air-cells of the lungs being thus opened, the elevation of the ribs in inspiration draws the air into the pleural cavity, whence the descent of the ribs in expiration forces it into the wound which the broken rib has caused in the parietal pleura, and thence into the subcutaneous tissue. The sensation of emphysema is so peculiar that when once recognised it can never afterwards be mistaken. It is a dry crackling sensation, perceptible on the very slightest touch, quite unlike any other phenomenon presented either in health or disease: and in cases of injury to the chest there is hardly any other source from which it can come except a wound of the lung.[2] At the same time it should be remembered that a small quantity

Emphysema.

[1] Prof. Bennett throws doubts on this, which is the usual opinion as to the ordinary displacement of the ribs in fractures by direct and indirect violence. From his researches it would appear that in the latter case also the fragments are usually displaced inwards (see 'Syst. of Surg.' 3rd ed. vol. i. p. 807, or 'Dublin Quarterly Journal,' March, 1876). This may be so, and yet it may remain true that *considerable* inward displacement is more likely to accompany direct than indirect violence: and certainly the preparations which I have seen of outward displacement have been, as far as I can recollect, from indirect force. A striking example is in the Museum of St. George's Hospital.

[2] In an open wound of the pleura without wound of the lung emphysema may occur, though it rarely does (see Gunshot Wounds), and emphysema may also occur in stabs implicating one of the large bronchi, and in rupture of the lung without fracture or wound.

of air may be forced into any punctured or lacerated wound. I have seen it in a wound of the leg, and once I saw a case in which emphysema existed to a slight extent over the back of the chest, and it had been hastily concluded that the ribs had been fractured, the only injury being a spike-wound at the back of the scapula. Such mistakes, however, must be very uncommon, and very little care is necessary to avoid them. When fracture of the ribs is complicated with a wound of the lung, the injury is, of course, much more serious than when no such complication exists. At the same time the lung is so prone to rapid union that if the injury be only slight the prognosis is not unfavourable. The first question is, whether or no to bandage the chest. Great surgical authority may be quoted on both sides. The fragments have certainly been displaced inwards, and, if this displacement be reproduced by bandaging, it may perpetuate an irritation which is very important to stop at once. On the other hand, the movements of the chest may also produce irritation around the fractured ends, and so in the wounded portion of the lung. The patient's feelings are the best guide. If the steady pressure of the hand on the seat of fracture is grateful to him, it is well to try the effect of a bandage, which, however, must be removed at once if it increases the dyspnœa or causes pain. Bandaging is certainly contraindicated when there is much comminution or tearing of the parietes of the chest, as happens sometimes in such accidents as a blow from a carriage-pole, where a large rent may be seen in the chest-walls, into which the air bulges in the form of a large bladder under the skin with each expiration. Besides these local measures, the treatment of fractured ribs with wound of the lung consists in perfect repose, with low diet (unless the patient be very weak at the time), until all fear of inflammation has passed over. The occurrence of inflammation will be proved more by the general symptoms of feverishness and dyspnœa, with rusty-coloured sputa and hacking cough, than by any physical signs, since the condition of the part often forbids percussion or auscultation. When this is not the case the use of the stethoscope is imperative. When inflammation is clearly marked nothing affords so much relief as bleeding, especially if done early. Venæsection is of course inadmissible if the pulse is very weak, but when there is much dyspnœa and a strong, hard pulse, the relief given by the abstraction of a moderate quantity (as 10 or 12 oz.) of blood on the first accession of the symptoms is often decisive. Antimony in moderate doses (say $\frac{1}{10}$th to $\frac{1}{8}$th of a grain every four hours) may also be given to robust patients; and if the symptoms call for it the bleeding may be repeated. In the weakly or in conditions of much depression a jacket-poultice should be applied, small doses of morphia combined with squills or some demulcent mixture ordered, and it may even be necessary to administer a little wine cautiously.

Complications of fractured ribs. Emphysema.

The emphysema in itself is usually of no consequence whatever. Cases are on record in which the cellular tissue has been said to be so blown up with air as to produce a real embarrassment to the patient's breathing, and to require evacuation by scarifications, but I have never met with anything of the sort. If necessary, however, any quantity of air might easily be let out through an exploring trocar introduced in a few convenient places. The air generally disappears of itself, being probably taken up by the fluids of the part.[1]

The other complications of fractured ribs are very numerous. Air, blood, serum, or pus, or a mixture of several of these fluids, may be effused in the

Spontaneous emphysema from rupture of a vomica, or even from rupture of the healthy lung by violent efforts, such as those of parturition, is a rare and curious affection.

[1] An interesting discussion on the mode of removal of the extravasated air will be found in Mr. Le Gros Clark's work, p. 204.

pleura; and in most cases of emphysema some air will probably remain in the pleural cavity, though if its exit into the cellular tissue be unimpeded the quantity will not usually be sufficient to cause any symptoms. Pneumothorax may, however, be present to an extent sufficient to cause embarrassment to the breathing, particularly if the wound in the parietal pleura has become closed, and in such circumstances the pneumothorax requires treatment. Besides dyspnœa, there will be unnatural resonance to percussion in parts away from the injury, flattening or convexity replacing the natural concavity of the intercostal spaces, increase in the circumference of that side of the chest, and loss of respiratory murmur. If the quantity effused be so great as to impede respiration, the air must be drawn off by a trocar or exhausting-syringe, and this must be repeated as often as necessary; but, as Mr. Le Gros Clark has pointed out, it hardly ever is necessary, since when the air is in quantity sufficient to press on the lung that very pressure opposes further extravasation of air.

Pneumothorax.

Hæmothorax.

Hæmothorax, again, may occur from wound of an intercostal artery or of some large vessel or vessels in the lung. Along with the dyspnœa there is in well-marked cases much depression or complete syncope, with other symptoms of internal hæmorrhage. The physical symptoms are those of fluid in the pleura (dulness on percussion, bulging of the intercostal spaces, loss of respiratory murmur), and often metallic tinkling or splashing from the admixture of air with the fluid, and combined with these often a dark colour under the skin of the loins, as if from sugillation of the blood through the pleura into the intermuscular spaces. If the patient seems to be really likely to die from the mere pressure of the blood, it is doubtless necessary to draw off the fluid part with the aspirator; or if this does not give the required relief, to make an incision and evacuate the semi-coagulated mass; but such measures are hardly ever required, and are deprecated by many good surgeons as interfering with the closure of the wound in the artery, which is favoured by the pressure of the clot.

The occurrence of hydrothorax or empyema as the result of pleurisy after an injury is marked by the same symptoms, and requires the same treatment as when such conditions occur under other circumstances, for which I must refer to works on medicine.

The other complications are much more rare, viz. lesion of the pericardium and heart, injury to the intercostal arteries, wounds of the diaphragm, causing laceration of the abdominal viscera. As all these injuries are much more common from other causes than from fracture of the ribs, they are best treated of separately.

Fractures of the ribs are not unfrequently compound, i.e. the ribs are often fractured in gunshot and other wounds of the chest, but the fracture of the rib is in these cases only a subordinate part of a much graver injury, which usually involves the lungs, heart, or great vessels. The general features of such injuries will best be understood from the remarks on GUNSHOT WOUNDS in a subsequent chapter, and from those which follow presently, on PENETRATING WOUNDS OF THE CHEST.

Fracture of costal cartilages.

The costal cartilages may be fractured, although I am not aware that the injury can be accurately diagnosed unless one fragment overlaps the other, which does occasionally happen. Delpech is quoted by Mr. Poland as saying: 'If the fracture takes place near the sternum the internal fragment passes in front and crosses the external; the contrary when the fracture is nearest

the rib.'[1] In such cases it seems difficult to get the fragments into their proper position; and as no serious inconvenience results from the displacement it is unwise to use any severe measures for that purpose. If the fragments can be manipulated into position, a bandage should be applied to keep them so. If not, I should be disposed to leave them to unite as they are. Malgaigne speaks favourably of the use of a kind of truss. The injury is usually repaired by bone, sometimes by a mixture of bone and cartilage. (See page 130.)

Fracture of the sternum.

Fracture of the sternum rarely occurs as a separate injury, but it is not very uncommon as a complication of fracture of the spine, and it sometimes though rarely accompanies fracture of the ribs. The rarity of fracture in a bone so exposed to violence as the sternum testifies to the efficiency of the protection afforded to it by the costal cartilages, which support it exactly like so many elastic springs. The sternum, however, is sometimes fractured by direct violence, by indirect force (as in fracture of the spine), and even by muscular action.[2] Some surgeons seem to believe that a frequent cause of fracture of the sternum is the forcible impact of the chin against the top of the bone in a violent bend of the neck. The fracture occurs generally through or near the junction of the first and second pieces of the bone, and what is called a fracture is often, as Mr. Rivington[3] has shown, a true dislocation, there being a regular diarthrodial joint in this situation. The symptoms somewhat resemble those of fracture of a rib, and there is not generally much difficulty in detecting it by manipulation even when there is no displacement, but very commonly the upper fragment is found behind the lower, leaving no doubt of the nature of the case. In fracture involving only the sternum there are rarely any visceral complications.

The treatment is much the same as for fracture of the ribs; the displacement often remains permanent, but no evil consequences need be feared from it, nor is the accident in itself a formidable one. Longitudinal fissures in the sternum have been dissected in the dead body, and more rarely recognised in the living by the displacement of the fracture.

Dislocation of the ribs.

Dislocation of the head of the rib from the spinal column, or of its extremity from the sternum, or from the cartilage, can hardly be spoken of as a separate surgical injury, since it is usually only a subordinate part of the case, and in any event its treatment would be exactly the same as that of fractured rib. In Mr. Lyell and Mr. Poland's article in the 'System of Surgery' the reader will find references to the recorded cases of this rare injury.

Penetrating wounds. Diagnosis between wound of the lung and wound of the pleura only.

Penetrating wounds are such as either open the pleural cavity only or pass more deeply, wounding the lungs, heart, or great vessels. There are no absolute signs by which a wound of the pleura only can be distinguished from one of the lung, since the passage of air out of the wound (traumatopnœa) is noticed in wounds which terminate in the pleural cavity. As the parietes of the chest rise up in inspiration the air finds its way through the wound into the pleural cavity, whence it is expelled into the cellular tissue (emphysema), or through the wound (traumatopnœa) in expiration.[4] However, when the lung

[1] 'Syst. of Surg.' 3rd ed. vol. i. p. 810.

[2] Lyell, in 'Syst. of Surg.' 3rd ed. vol. i. p. 812.

[3] 'Med.-Chir. Trans.' vol. lvii. p. 101.

[4] Nélaton gives four conditions under which emphysema may occur: 1. In a wound of the lung with external wound. The air passes during inspiration into the pleural cavity

is also wounded the expelled air is usually churned up with the blood in the lung into a fine bloody froth, the absence of which sign in a penetrating wound encourages the hope that the pleura only is wounded. Exploration with the finger or probe is only permissible when there is good reason for suspecting that a foreign body is lodged in the wound. Hæmoptysis may be present to a certain extent when the lung is not wounded, and, on the other hand, it may be (though it rarely is) absent when the weapon has passed into the lung. These remarks apply, however, of course rather to small punctures than to free wounds of the lung, the nature of which is usually obvious enough. In the graver cases of wound of the lung much air and blood will be effused into the pleura, and blood will also be extravasated into the tissue of the lung itself, so that the patient is menaced with death both from apnœa, the result of pressure on the lung, and syncope, caused by loss of blood and shock. The chief danger in wound of the lung, according to Mr. Le Gros Clark, is in the early loss of blood: 'if this peril be survived, the risk of fatal inflammation would appear to be less under favouring conditions than might be anticipated' (op. cit. p. 217).

All penetrating incised wounds of the chest, not involving fracture, should be closed at once, after the removal of any foreign substance, and it is a good practice in the severer cases, and those in which the lung is believed to be wounded, to strap the chest and apply ice externally. The collapse should not be interfered with at first, unless it be so severe that it threatens to prove fatal. The patient should be kept perfectly quiet and very cool. In fact, the object of the surgeon should be to avert hæmorrhage. In reaction as the pulse rises bleeding may be indicated, and afterwards, when inflammation threatens or has commenced, the treatment already described must be pursued (p. 199).

Wounds of the lung under favourable circumstances and in healthy persons unite rapidly, and the prognosis is by no means desperate. It need hardly be said that if dyspnœa seems to be excited or kept up by the collection of air or blood in the pleura, the surgeon may find it necessary to reopen the wound in order to give it exit.

Hernia of the lung.

Pneumocele, or the protrusion of a portion of the lung through the wound, takes place either immediately on the accident (primary), or after an interval (consecutive).

Primary hernia of the lung, when the protruding lung is exposed by a wound, forms a globular mass, varying in size from a marble to a cricket-ball. Its dark colour, shining surface, and crepitating feel sufficiently indicate its nature, and distinguish it from a protrusion of the omentum which has sometimes been observed in the lower intercostal spaces. If recent, and if it can be reduced without violence, this should be done, the tissues of the wound which constrict the neck of the protrusion being, if necessary, divided, in order to allow of the easy return of the lung into the thoracic cavity, when

from the open air-cells and from the outer air through the wound, and in expiration is pressed out through the wound or into the cellular tissue. 2. In a wound penetrating the parietal pleura but not the visceral, if there is any impediment to the free passage of the air out again through the wound. 3. In wound of the lung without external wound, as in fracture of the ribs. 4. In rupture of the lung without injury to the visceral pleura the air may be extravasated between the lobules of the lung, causing emphysema at the root of the lung, which extends into the lower part of the neck. [I cannot remember ever seeing this accident.] In rupture of the lung without injury to the parietal pleura pneumothorax will occur, but no emphysema. ('Nélaton, 'Path. Chir.' vol. iii. p. 447.)

the wound is to be united. But if some time have elapsed, and the lung be altered in structure, no attempt at reduction should be made, nor is any other mechanical interference permissible—the herniated lung must be allowed to slough off. Some surgeons think it better to tie a ligature round the herniated portion, which may afterwards be removed if it be thought advisable, when the protruded part has contracted adhesions to the parietes.[1]

Primary hernia of the lung takes place also beneath the skin in cases of extensive fracture of the parietes of the chest accompanied by free laceration of the soft parts. In such cases it is useful to repress the protrusion by a carefully applied pad.

Consecutive hernia takes place after the wound has cicatrised, so that the lung is covered by skin or cicatrix. It forms a globular, elastic tumour, which falls in during inspiration, disappears in holding the breath, and swells in expiration, and particularly in coughing.[2] On manipulation it crepitates, and auscultation detects a harsh-toned vesicular murmur.

Nothing can be done, beyond protecting it, if it seems necessary, from any accidental injury by adjusting a concave shield over it. This will also obviate any chance of the increase of the protrusion.

Foreign bodies lodged in the thorax.

Foreign bodies which are lodged in a wound of the chest must be extracted at once, and many histories testify to the possibility of recovery even after complete perforation of the thorax by a very voluminous foreign body, as in the celebrated preparation in the College of Surgeons' Museum, from a man who lived ten years after having a gig-shaft run through his chest from one side to the other. And life is not incompatible even with the permanent lodgment of a foreign body, as in Velpeau's case of a man who lived fifteen years with part of a fencing-foil in his chest, which had entirely traversed the thorax, the point being implanted in the spine, the broken end fixed in one of the ribs, and the weapon itself buried in the lung, where it was surrounded by calcareous deposit.[3] But such exceptional cases as this do not invalidate the general rule that foreign bodies should be removed at once whenever it can be done without too great risk. Sometimes the foreign body (usually a bullet) drops into the pleura, and thus may entirely escape detection, though in some such cases the substance has been found by a probe, and has been extracted either by a pair of forceps or by direct incision. If the foreign body be left in the pleura it will probably produce death by pleurisy and empyema, though it is certainly not impossible that it might become encysted.

[1] See a case very clearly and succinctly described in 'Med.-Chir. Trans.' vol. xx. p. 378, by Mr. Forde.

[2] This is the usual account in the present day of the changes in volume in herniated lung during the movements of respiration. See Nélaton, 'Path. Chir.' vol. iii. p. 463; 'Syst. of Surg.' 3rd ed. vol. i. p. 827. But Mr. Le Gros Clark (op. cit. p. 206), in relating a case of primary hernia of the lung with fracture of the ribs, distinctly observed that 'at each inspiration a large tumour, of the size of the doubled fist, presented itself below the clavicle; and this disappeared at each expiration, leaving a deep depression.' Nélaton gives a mechanical explanation of the falling in of the herniated lung during inspiration which does not appear to me quite clear. He says: 'During the dilatation of the chest the portion of lung situated outside is not able to participate in the distension of the viscus contained in the cavity' [but *query* why?] 'and as there is a tendency to a vacuum in the intrathoracic part of the organ, if the hernia is reducible it enters the chest; if not it empties itself completely. These results,' he adds, 'are confirmed by accurate observation, but are contrary to what is found in authors.' We must conclude that both conditions are found. I saw a case many years ago, in which, if I can trust my memory (for I cannot now find the notes), the movements were as described in the text.

[3] 'Syst. of Surg.' 3rd ed. vol. i. p. 836.

Wounds of the mediastinum, pericardium, and heart.

In some cases weapons have penetrated the mediastinum without wounding any important parts, and in still rarer cases the pericardium has been wounded, and yet the heart has escaped injury;[1] but no diagnosis can, I think, be made between the latter injury and that in which the heart is also wounded.

The symptoms of wound of the heart are chiefly those of acute internal hæmorrhage, which usually proves rapidly fatal. There is a peculiar tremor about the heart, with intermittent small pulse; and there is also a peculiar undulous crepitation and bruit accompanying the heart's action, and due to the blood effused around it into the sac of the pericardium. The position of the wound, and the severe symptoms which accompany it, are the only tests of the reality of the injury to the heart itself.

Death is the ordinary but not, as it seems, the inevitable consequence of wound of the heart. The wound usually proves fatal by hæmorrhage into the pericardium, the blood collecting about the heart and impeding its motion; or in case of a free opening into one of the cavities the mechanism of the heart may be destroyed, the blood passing so freely out of the heart that its pumping action is suspended.[2] A wound of the heart may also prove fatal at once by the 'shock' to the heart or subsequently by pericarditis, or from some of the many complications of penetrating wounds of the thorax. But there seems no question that in man and other warm-blooded animals wounds of the heart do not always prove fatal. Animals have been dissected in whom foreign bodies have been found which had been lodged for years in the substance of the heart, and others who bore the plainest marks of old scars. Nor are similar cases by any means so uncommon as is sometimes supposed in the human subject. Fischer has recorded 452 cases in which wound of the heart or pericardium was diagnosed, and out of these 72 recovered, and the diagnosis was in 36 cases verified to the satisfaction of the surgeon by post-mortem examination.

In a case the preparation of which is in the Museum of St. George's Hospital, the symptoms were at the time ill-marked, though the heart was perforated: the bayonet having passed through the wall of the left ventricle and opened its cavity. The patient was a young man, a Volunteer, who accidentally fell on his bayonet. He withdrew the weapon, ran a short distance, and then fainted. When seen at the Nottingham Hospital, an hour afterwards, he bore traces of great loss of blood internally, but this seemed chiefly in the left pleura, from which a pint and a half of blood was drawn off next day. On the day after the accident pericardial friction was detected. He lived four days.[3]

'The treatment,' says Mr. Poland, 'will be mainly directed to prevent and arrest internal hæmorrhage, by absolute repose, local and general employment of cold, and early venæsection to relieve the heart:' and he also recommends the internal use of belladonna and digitalis.

Paracentesis pericardii.

Paracentesis of the pericardium has been contemplated in wounds of the heart in order to disembarrass the heart of the effused blood, but has never been performed for that cause. It has, however, been occasionally resorted to when effusion into the pericardium, the result of disease, could be distinguished to

[1] On this subject consult Fischer, Ueber die Wunden des Herzens und des Herzbeutels, Langenbeck's 'Archiv,' 1868.

[2] Mr. Le Gros Clark describes and figures a most interesting case of bullet-wound of the heart, in which the man survived fourteen days, though there was a transverse laceration an inch in length in the right ventricle near its root, and the tricuspid valve was also lacerated (op. cit. p. 250).

[3] 'Med. Times and Gaz.' 1863, vol. ii. p. 487. St. George's Hospital Museum, ser. vi. No. 224.

such an extent as seemed likely to prove fatal. The operation is best performed in the fourth or fifth intercostal space, just to the left of the sternum, in exactly the same manner as paracentesis of the pleura,[1] or the parts may be dissected until the distended pericardium is exposed. In a case recently published,[2] the operation is thus described: 'A fold of skin having been raised over the fifth intercostal space, an incision a little more than an inch long was made parallel to the ribs, in the centre of the space, commencing about two-fifths of an inch to the left of the sternum. The layers of muscle were then carefully divided, and an elastic dilatation was felt, which resisted a little under pressure, while the impulse of the apex of the heart could be indistinctly perceived. A puncture having been made in this, the point of a small trocar was introduced, and about 10 ozs. of fluid were removed, with immediate relief.'

Evacuation of pus in the pericardium by incision.

Two cases are now on record in which a purulent collection diagnosed as having been contained in the pericardial sac has been evacuated by a free incision, washed out, and drained with complete recovery. A paper by Dr. S. West, recently read before the Royal Med. and Chir. Soc.,[3] records one of these cases, and gives the statistics of the operation of paracentesis pericardii up to the date of publication.

Wounds of the internal mammary and intercostal vessels.

Many great vessels may be wounded in the cavity of the chest, but the only cases which need engage our attention, since they are the only ones susceptible of definite diagnosis and treatment, are the wounds of the internal mammary and of the intercostal arteries, and these are very rare, at any rate as substantive injuries. It is possible that an intercostal artery may be occasionally injured in fracture of the ribs, but I am not aware that this has been proved by dissection. The internal mammary artery may be wounded in any of the first three spaces by a stab-wound on either side of the sternum without any division of the costal cartilages. Below the fourth costal cartilage it is said that it can only be divided by section of the cartilage, and in more than half the cases that have been noted the costal cartilage has also been cut.[4] An artery laid open through a wound of so dense a structure as the costal cartilage can hardly be brought into view. When the artery is wounded in any of the upper three intercostal spaces it may, according to M. Tourdes, be tied by direct incision.

The intercostal artery may be wounded in paracentesis or in a punctured wound or gunshot injury, and it may be perfectly impossible to secure it in consequence of its remote position as well as the retraction of its divided ends.

It is not easy in either case to distinguish the source of the bleeding, though there would be less doubt in the case of the internal mammary artery than in that of the intercostal. The symptoms of bleeding from the latter differ but little from those of hæmorrhage from a wound of a vessel in the lung, for in accidental injuries at least (as distinguished from surgical operations) the lung is in all probability wounded. The main diagnostic sign is the effect of pressure with the finger introduced into the wound, which may be enlarged for the purpose. It has also been proposed to introduce a strip of card or a

[1] On paracentesis of the pericardium see Allbutt, in 'Lancet,' June 12, 1869.

[2] 'Lond. Med. Record,' May 5, 1875, p. 275.

[3] 'Brit. Med. Journ.' April 28, 1883.

[4] See Tourdes, 'Annales d'Hygiène Publique,' vol. xlii. p. 165, where summary notes are given of eleven cases: in five of which, however, the diagnosis was not verified by post-mortem examination. This author insists strongly on the necessity of ligature of this vessel when wounded, but I am not aware that the operation has ever really been practised.

thin spatula into the wound, and judge of the source of the hæmorrhage by seeing on which side of the card the blood runs down. If the card is introduced into the pleura beneath the intercostal artery, it is clear that if that artery be the source of the bleeding the blood will run along the outside of the card, and if the bleeding be from the lung, along its inside.

The treatment of wounds of either of these vessels has generally been unsatisfactory. There are, indeed, some cases in which the surgeon can tie the wounded artery, but they are exceptional. In other cases it may be possible to keep up pressure by the fingers of a relay of skilled assistants long enough to avert death by hæmorrhage: or possibly the plan of uncipression recommended by Signor Vanzetti might find its use here (see page 98): or an oval sponge on a ligature might be introduced into the wound so shaped that when it swells up it will not come out of the opening when the ligature is drawn outwards, but will make pressure outwards on the bleeding vessel. Many good surgeons, however (as Larrey,[1] in the case of the internal mammary, and Assalini in that of an intercostal artery), think that the patient has on the whole a better chance of recovery if the wound is simply closed, and coagulation is trusted to to repress the hæmorrhage, paracentesis being performed if the blood accumulates in the pleura[2] to such an extent as to threaten life.

Rupture of viscera without wound or fracture.

The heart is sometimes ruptured even in cases where there is no direct injury to the chest. Thus, in the case of a mason's boy who fell from the roof of St. George's Hospital and was killed on the spot, among other fatal lesions the septum ventriculorum of the heart was found ruptured without any other injury of the chest. But such lesions hardly come within the range of practical surgery.

In severe contusions of the chest (and usually from the passage of a carriage wheel over it) the lung is sometimes lacerated without the chest-walls sustaining any visible injury. Doubtless at the time of the accident the glottis is spasmodically closed, and then the lung is torn between the force impressed on it through the chest-walls and the resistance of the air confined in the bronchi. The injury may be diagnosed when the visceral pleura is also ruptured; but, I should think, not otherwise.[3] The symptoms in that case will be hydropneumothorax (dulness at the lower part of the chest, sonorous resonance at the upper, and metallic tinkling, possibly with splashing on succussion), and at the same time dyspnœa, hæmoptysis, and sometimes subcutaneous emphysema, without any fracture of the ribs. The accident is much more likely to occur in childhood, from the elasticity of the chest-walls. The treatment is directed to avoid and combat the resulting inflammation, as in any other severe injury of the chest, and there can be no doubt that some cases end in recovery.[4]

Paracentesis thoracis.

The present seems the best place to introduce a description of the operation of paracentesis thoracis, or thoracentesis.

[1] Larrey speaks thus: 'It is much better to leave hæmorrhage from the intercostal or internal mammary artery to nature. The wound being closed, the blood accumulates in the thorax, and the lung, no longer compressed by the air, dilates again and fills up the cavity.'—'Clin. Chir.' vol. ii. p. 181.

[2] In wounds of the internal mammary, low down, even the pericardium may be opened and may be filled with blood.

[3] See, however, above (p. 202, footnote), Nélaton's observations on the occurrence of emphysema at the root of the neck in cases of laceration of the tissue of the lung without rupture of the visceral pleura.

[4] The chief authority on this subject is M. Gosselin's elaborate article in the first volume of the 'Mém. de la Soc. de Chir. de Paris.'

Tapping the chest is a very simple operation, and one which has now become so familiar that it is often performed by students or junior practitioners. In fact, with some simple precautions, it involves little risk of its own. At the same time, when performed on account of disease, or when the contents of the chest are, from previous disease, in unnatural relations to each other, it is not either so simple or so harmless. The objects of the operation are to evacuate fluid from the pleural cavity without injuring the intercostal vessels, the lung, or the diaphragm; to avoid the entrance of air in place of the fluid removed; and to do this without any lesion of the lung due to the change in the conditions of atmospheric pressure which may be caused by emptying the fluid out of the pleura.

In order to fulfil these several indications the first thing is to make sure that there is really fluid in the pleura at the point selected for tapping; by percussion, giving dulness; by auscultation, showing the absence of respiratory murmur; by the change in the shape of the intercostal spaces, bulging outwards from the pressure of the contained fluid, instead of being concave, as in the

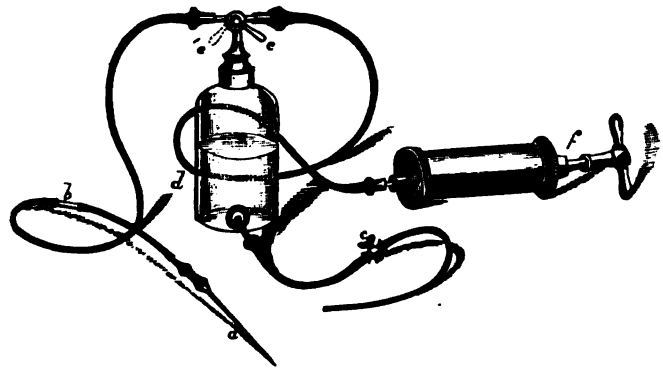


Fig. 69. The Aspirator. *a*. The perforated needle or sharp-pointed canula, which is introduced into the collection of fluid. It communicates with the bottle, *d*, by means of an indiarubber tube, which is interrupted at *b* by a portion of glass tubing, so that the nature of the fluid evacuated can be judged of at once, and the canula either plunged deeper or withdrawn. When the handle, *c*, is in the position shown in the figure the communication between the canula and the bottle is closed. The bottle is then exhausted of air by means of the pump, *f*. When *c* is moved to *c'*, the canula-tube is opened. *e* is the waste-tube of the bottle, and is closed by a button at *e*. In using the aspirator the vacuum is formed, and the handle, *c*, is kept in the position shown till the canula has been introduced into the fluid, then it is turned to *c'*, and the fluid fills the bottle. If there is still more fluid, the handle is turned back to *c*, the waste-pipe opened, and the fluid emptied out of the bottle, which is then again exhausted, and the handle turned back to *c'*. This is one of the simplest of the many forms of the aspirator.

natural condition; by the increased measurement of the affected side of the thorax, and by the displacement of viscera, particularly the heart. The next thing is to make the opening near the upper border of the lower rib, since the main intercostal vessels run near the lower border of the upper rib. The best plan, I think (unless the parietes of the chest are unusually thin), is to make a lancet puncture on the lower rib, put a finger-nail into the puncture, and enter the trocar above the finger-nail. The shape of the trocar seems of little moment. The lung can hardly be injured if there is plenty of fluid below the trocar. The diaphragm is avoided by not going too low. A favourite seat for paracentesis is in the fifth or sixth intercostal space, and just in front of the angle of the scapula, where the intercostal spaces are at their broadest. The entrance of air may be best prevented by using an exhausting syringe. One fashioned like a stomach-pump was in use many years ago, and acted very well. At present Dieulafoy's aspirator is more commonly employed, and certainly answers its purpose admirably. But in tapping the chest it must be recollected

that if fluid is to be removed and no air is to replace it, this is only mechanically possible on the condition that the lung shall rise up to take the place of the fluid; for the only other way in which the vacuum could be filled would be by the bulging inwards of the chest walls.[1] But in ordinary circumstances the parietes cannot yield to any appreciable extent. Now, if the lungs are bound down by adhesions, and attempts to exhaust the fluid are made with considerable force, the atmospheric pressure, acting through the air-passages on the tissue of the lungs, is no longer balanced by the pressure of the parietes, and the tissue of the lungs is forcibly thrust towards the pleura by the air inside them, to their great detriment. Instances are not wanting in which the lungs have thus been torn. Too forcible suction applied to the vascular false membranes which often occupy the pleural cavity in these cases, may also give rise to hæmorrhage into the pleura. Therefore the attempt to withdraw the fluid without the admission of air should not be persevered in if there is much resistance. And I cannot say that I am myself convinced of the great danger of the admission of air in thoracentesis. Much difference of opinion exists on the subject.[2]

The patient should sit across the bed, supported by an assistant, and as the fluid escapes he should be lowered nearer the horizontal position, the assistant keeping his hands on the two sides of the chest. As soon as the fluid begins to stop it is better to withdraw the trocar, closing the opening at once with the finger and then with strapping, and restoring the patient to the horizontal position.

When the fluid is purulent, especially if mixed with flakes of solid substance, it seems better to make a small incision along the upper border of the rib. This is conveniently done by puncturing the pleura with a grooved needle, along the groove of which, when the pus has been found, a small knife can be passed. In some cases, and especially when the matter is putrid, a second incision should be made lower down in the pleural cavity, through which a drainage-tube can be passed from the original opening, and the cavity washed out with some disinfectant, as carbolic lotion, Condy's fluid, or Tinct. Iod. sufficiently diluted. Latterly it has become rather common, in cases of fistula after the operation for empyema, to resect a portion of one or two ribs with a view of making a freer opening for the discharge and possibly of allowing the thoracic parietes to collapse or come down upon the cavity. The operation seems free from serious danger, and is well worth trying in cases of chronic empyema where the opening shows no tendency to heal. The periosteum should be carefully rasped off the portion of bone to be removed, and with this membrane the intercostal vessels and nerves will be raised.[3] I have only had occasion to resect portions of a rib in one case, in which it became necessary to repeat the operation, and then it fully answered my expectations. I removed on the first occasion about an inch of one rib; but the opening soon contracted so much that I was obliged to remove another portion. In other cases parts of several ribs have been excised, and it has been recommended to remove the thickened and unyielding false membrane which in some cases is found coating the pulmonary pleura.

Resection of a portion of rib.

[1] The diaphragm no doubt might be pushed upwards to some extent, but this can be of little account.

[2] See a controversy in the 'Brit. Med. Journal' (1871, vol. i.) between Dr. Fuller, Dr. Playfair, Dr. Douglas Powell, and others, as to the possibility of preventing the entrance of air into the pleura in paracentesis, and as to the importance of doing so, if possible.

[3] 'Lond. Med. Record,' 1880, p. 252.

CHAPTER XII.

INJURIES OF THE ABDOMEN.

Contusions.

Blows on the abdomen are always to be regarded with some apprehension. They often produce a good deal of immediate shock, even when no permanent ill-effects follow. That a severe blow on the epigastrium may destroy life by mere shock, without any visible lesion, is an old doctrine which cannot be said to be exploded, although Mr. Pollock has shown that much of the evidence on which it rests is highly unsatisfactory.[1] If the fact is true its explanation is probably to be sought in some direct effect on the great sympathetic system around the semilunar ganglia, analogous to 'concussion' of the other great nervous centres. But the event is unquestionably a very rare one, and its treatment would resolve itself into that of collapse (see p. 103). The more formidable immediate dangers in contusions of the abdomen are rupture of one of the abdominal viscera, or laceration of the peritoneum, followed by acute peritonitis, or by chronic peritonitis, or suppuration in or beneath the abdominal walls.[2] Cases where there is no symptom of visceral lesion, but where the blow has been severe, and the pain is great or extravasation extensive, should be watched with much care. The bowels should be kept inactive for several days by doses of opium proportioned to the amount of pain, warm fomentations sprinkled with laudanum or turpentine should be applied over the belly, or leeches to the painful part; and all distension of the intestines should be sedulously avoided, the patient being kept on meagre diet given in very small quantity, at short intervals. If peritonitis comes on it must be treated according to the general symptoms and the patient's state of health. In all cases opium is to be given by the mouth, or morphia injected subcutaneously; in cases of sthenic inflammation I entertain no doubt of the good effects of mercury; and in such cases free bloodletting is very advantageous—twenty or thirty leeches to the abdomen, repeated if necessary—or even venæsection. In cases of low diffuse suppuration (whether internal or external to the peritoneal cavity), with quick weak pulse, vomiting, tympanitis, and dry tongue, stimulants, even in large quantity, may be required. Suppuration near the seat of injury should be carefully watched for, and an early and free exit given to the matter.

Rupture of the stomach.

The stomach is very seldom ruptured without direct wound, and when this does take place the collapse is sudden and complete, and death occurs in a few hours. In a well-marked case published by the late Mr. Moore,[3] one of the main symptoms was the excruciating pain which was caused by the administration of small quantities of brandy. There will probably be urgent thirst,

[1] See 'Syst. of Surg.' 3rd ed. vol. i. p. 864. Mr. Le Gros Clark, whilst admitting the possibility of fatal shock without visible lesion, says that he has never met with such a case. (Op. cit. p. 267.) The present edition of Mr. Pollock's essay does, however, contain a case, which I think is conclusive as to the reality of the occurrence. (Op. cit. p. 867.)

[2] In some cases of severe contusion of the abdomen the muscles may be more or less lacerated. It is the rectus which is usually the seat of this injury.

[3] See 'Syst. of Surg.' vol. i. p. 876, 3rd ed.

but there will be no vomiting, unless the rupture be very small or incomplete. No accurate diagnosis is possible, and no treatment can be of any avail. Mr. Pollock conjectures that in some cases of small laceration, occurring possibly between the attachments of the layers of omentum, the patient may temporarily recover, with a gastric fistula, and quotes a case which may be so interpreted.

The diaphragm may also be ruptured by a severe contusion. The only known consequence is a phrenic hernia. The subject is discussed in the chapter on HERNIA.

Rupture of the bowel.

Rupture of some part of the intestine is a tolerably frequent and a very fatal injury. It occurs in any part of the bowel, 'from the commencement of the duodenum to the termination of the sigmoid flexure of the colon' (Pollock). The laceration varies in extent, being sometimes little more than a pinhole, at others involving the whole or almost the whole circumference of the bowel.

The injury is caused by severe contusion, such as the kick of a horse or the passage of a wheel over the abdomen when the intestine is full; for there is no evidence, as far as I know, that the intestine can be ruptured when collapsed; and this is a very important distinction between rupture from contusion and perforation by direct wound. Many instances of sword and bullet wounds of the intestines have been recorded in which recovery has ensued, though the occurrence of fæcal fistula has proved the reality of the lesion of the bowel.[1] And such cases are easily intelligible if we suppose that the bowel was empty at the time of the wound, so that no fæcal fluid or gas escaped into the peritoneal cavity at the moment of the perforation. For the mucous membrane of the bowel protrudes at once through the lips of the wound in the muscular and serous coats, and, assisted by the contraction of the muscular fibres, so effectually closes the aperture that no extravasation takes place at the moment of the wound; nor would any extravasation occur at all if renewed distension could be prevented. By the time that the injured bowel becomes distended with fæces its wounded part has contracted adhesions to the neighbouring coils and to the parietes, so that the fæces find their way out of the external wound, not into the peritoneal cavity. This protrusion of the mucous coat occurs also in the case of internal rupture.[2] But here, since the bowel is distended when ruptured, and since there is no exit for the contents except through the wound, there must occur instantaneously on the rupture a free escape of fæcal gas at any rate, and in all probability an effusion also of fæcal fluid into the peritoneal cavity, though the latter may sometimes be in such small amount as not to be discoverable after death. Thus the germs of fatal inflammation are in all probability implanted on the serous membrane; and there is not, as far as I can discover, any perfectly satisfactory proof that complete rupture through all the coats of the bowel without external wound has ever been followed by recovery. At the same time there have unquestionably been cases in which

[1] Amongst many other equally convincing cases I would refer the reader to one illustrated by a very striking photograph in the Circular No. 6 of the American Surgeon-General, Nov. 1, 1865, p. 26. In this case the ball had passed clean through the abdomen and emerged near the spine. There had been fæcal discharge from both wounds, and a mass of sphacelated omentum was discharged from one of them. Still the patient recovered, and was in perfect health at the date of the report.

[2] See a case by Mr. Partridge, 'Path. Trans.' vol. xii. p. 109, where death occurred eight days after laceration of almost the whole circumference of the jejunum. The mucous membrane had so completely plugged the opening that there was no trace of extravasation of the contents of the bowel into the peritoneal cavity.

the symptoms have been held to justify the diagnosis of ruptured bowel which have ended in recovery; and the theoretical possibility of recovery, even in cases of complete rupture, has not been disproved; for we are not entitled to assert that the effusion of fæcal gas must inevitably prove fatal; and there is again the remote possibility that although the bowel may be ruptured, yet the rupture may not implicate the peritoneum. Consequently the injury must be treated with a view to recovery.

Rupture of the intestine can generally be diagnosed. After a severe blow on the abdomen acute pain comes on shortly before the pain of the injury has subsided, often accompanied with much collapse (though not always so[1]), with urgent vomiting, intense thirst, great tenderness of the abdomen, involuntary contraction of the abdominal muscles, usually rapid sinking, with coldness of the surface, lividity, and loss of pulse some time before death. As the case goes on the vomit, which at first consists merely of food, becomes bilious, and then more and more resembles the contents of the small intestines; but I have never seen absolute fæcal vomiting. Tympanitis usually succeeds, probably from paralysis of the bowel—the result of an impression on the sympathetic system of nerves. The collapse which depends on general shock may, as Mr. Le Gros Clark points out, be distinguished from that caused by hæmorrhage, since in the latter case 'the patient usually refers his suffering to some isolated spot, where fulness or dulness on percussion, or both, may be detected.'

Treatment must of course be directed to prevent any re-opening of the laceration—i.e. to keep the lacerated bowel perfectly quiet until union has occurred; and this is the more important when we recollect that even if we believe all complete lacerations of the bowels to be fatal, yet we often see in cases of hernia the distended intestine partly lacerated on its external surface by injudicious violence, and that if the same thing took place in contusion it might produce symptoms very similar to those above described. Now, such an incomplete laceration would doubtless heal under favourable circumstances, if the part is kept at perfect repose, whilst distension and movement might easily render it complete, or set up fatal inflammation.

Absolute rest must be enforced—i.e. the patient must be not only confined to bed, but be prevented from making the slightest movement which can disturb the abdomen; opium must be administered in small doses often enough to relieve the pain, if possible, and to keep the bowels quite quiet, while any renewed distension of the intestine must be avoided by a rigid abstinence from food. Just so much fluid nutriment must be given in very small quantities as will support life, and thirst must be alleviated by sucking small pieces of ice.

If the patient survives for some days, and peritonitis then comes on, it must be treated according to the usual indications.

Rupture of the liver or gall-bladder.

Rupture of the liver is a tolerably common injury, and one which is not necessarily fatal, though it usually is so.[2] Cases have occurred in which a rupture of the interior of the liver has been found, the peritoneal coat being entire, and such injuries are evidently susceptible of repair, if they do not involve too large vessels. But it seems certain also that small lacerations of the surface of the liver may heal. I once saw a case[3] in which all the symp-

[1] See, in 'Syst. of Surg.' 3rd ed. vol. i. p. 877, a striking instance of the complete absence of collapse an hour after the receipt of an injury in which the bowel was ruptured.

[2] Mr. Le Gros Clark takes a still more favourable view of these injuries. He says: 'If the first effects of shock and hæmorrhage are survived, recovery from lesion of the liver or kidney is probably not infrequent.' (Op. cit. p. 292.)

[3] 'Path. Soc. Trans.' vol. xi. p. 140.

toms of laceration of the liver were certainly present. The man recovered, and, about a year afterwards, died from another cause. On dissection traces of some injury were found on the surface of the liver, though it was impossible to say exactly what the extent of the lesion had been.[1]

Rupture of the liver is also sometimes produced by fragments of the ribs perforating the diaphragm. Such injuries are almost of necessity fatal. Uncomplicated rupture of the liver causes death primarily either by hæmorrhage or by extravasation of bile into the peritoneal cavity, and secondarily by peritonitis. When, therefore, the laceration extends into one of the large bile-ducts or the gall-bladder,[2] the injury must prove fatal; and when the substance of the organ is so deeply broken up that several large vessels are laid open the bleeding can hardly be expected to stop. It is only the more superficial injuries in which recovery can be anticipated.

The diagnosis of rupture of the liver must commonly be only conjectural, resting on the nature of the accident, the pain over the region of the liver (which is by no means always observed), the collapse, the symptoms of hæmorrhage, and occasionally the accumulation of fluid in the peritoneum.

The treatment must be, as in all other similar injuries, *absolute* rest, small and repeated doses of opium, the application of ice to the part, and possibly the administration of styptics.

If peritonitis comes on afterwards, the usual treatment must be adopted, though antiphlogistic measures must only be employed with the greatest caution.

Rupture of the spleen.

The symptoms of rupture of the spleen are practically indistinguishable from those of rupture of the liver. The situation of the contusion, if known, will justify a conjecture that it is the spleen rather than the liver which is ruptured, but no exact diagnosis can be made. The treatment, however, being identical, no importance attaches to the differential diagnosis. The spleen being a still more vascular organ than the liver, its laceration usually produces even more acute hæmorrhage.

Rupture of the kidney and ureter.

Rupture of the kidney is more common than that either of the liver or spleen, and it is a far less formidable injury, since it seldom involves the peritoneum. In fact, it seems probable that the real nature of the injury in many of the cases classified as 'ruptures' might be more correctly described as 'bruise,' there being probably no visible laceration. There is no doubt, however, that extensive lacerations may heal, and a preparation in the Museum of St. George's Hospital[3] shows a rupture which has divided the kidney into two parts and obliterated the ureter, but from which the patient entirely recovered, dying a year afterwards in consequence of granular degeneration of the other uninjured kidney.

The symptoms of uncomplicated rupture of the kidney are merely those of a bruise on the back, with hæmorrhage into the bladder, occurring immediately on the injury. In the case above referred to this hæmaturia was very transient, lasting only a single day, for the ureter had evidently been obstructed

[1] Mr. Pollock quotes from the records of St. George's Hospital a still more conclusive case. A man died from the effects of fracture of the spine three weeks after the accident. An extensive but not deep laceration of the liver was found, which had almost entirely healed. 'Syst. of Surg.' vol. i. p. 880, 3rd ed.

[2] For a case of rupture of the gall-bladder see Fergus, 'Med.-Chir. Trans.' vol. xxxi.

[3] Ser. xi. No. 4. The case is reported in 'Path. Trans.' vol. xi. p. 140.

the coats of the stomach, and tied over bougies or buttons on the skin, the inner ring of suture uniting the stomach to the edges of the wound. If the symptoms admit of it, the parts are then to be left quiet for a few (say four or five) days. In more urgent circumstances it may be necessary to make the opening much sooner, or even immediately. It seems better to make the opening very much smaller than used to be the practice. Mr. Durham speaks of an incision about a quarter of an inch long; Mr. Bryant of a mere puncture with a tenotomy knife. The elasticity of the tissues allows a fair-sized tube to be passed through a very narrow opening, and prolapse of the lining of the stomach is thus obviated.

Other operators (as Sédillot and Lowe) have made a crucial incision. But on the whole the best incision seems that used by Mr. Bryant and Dr. Maury —'curvilinear, the convexity presenting towards the median line, commenced at the sternal extremity of the seventh intercostal space, and carried downwards and outwards for nearly four inches, exposing the sheath of the rectus muscle.' This seems to give readier access to the stomach, and to involve less tension on the sutures than the vertical incision in common use.

After the operation it is well to leave the parts entirely alone as far as may be, and therefore to support the patient by nutrient enemata as long as possible, in order that after the removal of a foreign substance the wound in the stomach may heal; or, in the formation of a fistula, that the edges of the skin and mucous membrane may unite before any food is introduced into the stomach. And this forms another argument for the early performance of the operation, since if the patient is very much exhausted it may be absolutely necessary to feed him by the stomach at once.

there is any reason to suspect the lodgment of a foreign body the wound should be very gently yet thoroughly explored, and the foreign substance at once removed.

When any foreign body present has been removed and all bleeding vessels carefully secured, the wound is to be sewn up, and the patient kept in such a position as will keep the walls of the belly relaxed. Even if the wound is somewhat lacerated, it seems better to bring its edges into apposition. In cases of extreme laceration the surgeon must use his own judgment, inclining towards such an amount at any rate of apposition as will secure the patient against the protrusion of the intestines through the wound. Ventral hernia is a common consequence of abdominal wounds, which is spoken of in the chapter on HERNIA.

Simple penetrating wounds.

2. (*a*) Penetrating wounds, in which there is no indication of injury to the viscera, or in which the viscera, being exposed, are known to be uninjured, are to be treated in the manner so familiar to surgeons in operations for hernia and ovariotomy, i.e. they should be brought together deeply enough to ensure the union of the wounded surfaces of the peritoneum, and the patient should, if it seems necessary, be kept moderately under the influence of opium. Whether the sutures are passed actually through the peritoneal edges or no seems of little importance, provided they are placed so close to the peritoneum as to keep the wounded portions of the peritoneum in contact, but it appears to me safer to take up the peritoneum as well as the abdominal wall in the suture. The suture will really, in a very short space of time, be outside the peritoneal cavity, being buried in effused lymph, while, if the stitches are passed outside the peritoneum, and the edges of the wound in the peritoneum should not be in contact, a ready way is left open for the percolation of inflammatory material into the cavity of the peritoneum. With reference to the administration of opium, it is well, I think, to be governed more by symptoms than by routine. I would refer the reader on this head to remarks, in the chapter on HERNIA, on the management of cases after herniotomy.

Wounds of viscera which do not protrude.

(*b*) Wounds in which the viscera are wounded but do not protrude are amongst the most serious injuries met with in the abdomen, and, the smaller the wound is, the greater may be the danger. Gunshot wounds are spoken of in another chapter; the injuries commonly met with in civil practice are either stabs or incised wounds. In these the surgeon can often only suspect the visceral injury from the pain and collapse which are present, at other times the escape of the contents, urine, fæces, bile, or gas through the wound affords a certain proof of the nature of the lesion. Unfortunately nothing can be done. It would be useless to cut down on the viscus with the hope of preventing the escape of secretion into the peritoneum, for if the peritoneum has been opened this effusion has already taken place. An enterprising surgeon might think it worth while to lay the peritoneal cavity freely open, stitch up the wounded viscus, and wash the membrane over with an antiseptic lotion, afterwards uniting the wound; and I should myself regard the operation as fully justifiable, but I am not aware that it has been tried. In all other respects the injury must be treated like any other grave wound of the abdomen.

Wounds with protrusion of uninjured viscera.

(*c*) When any of the abdominal viscera protrude uninjured through a wound, the first care of the surgeon should be to free their adhesive peritoneal surface from any small foreign bodies which may, and very often do, stick to them; then return them into the belly with as little violence as possible, and treat the case exactly as after strangulated hernia. The bowel or omentum protrudes much more often than any of the solid viscera or than the bladder.

The intestine, if unwounded, should in all cases be returned, even though somewhat contused or abraded, and for that purpose, if the accumulation of air in the bowel, or the thickening of its coats from obstruction, has rendered it impossible to pass it back otherwise, the wound is to be gently enlarged by a very slight nick in one or two places, just as in hernia. A precaution is to be observed which is hardly required in hernia, viz. to be very careful not to push the bowel into an interstice between the muscles or into the subperitoneal tissues. The finger should be passed fairly through the wound, to make sure that the reduction has been complete. The omentum, though not absolutely wounded, is often so altered in texture from exposure or obstruction, or so beset with foreign bodies, that the surgeon may fairly prefer to remove it after passing a ligature through its base, of course making sure first that no bowel is implicated in its folds.

When any part of the solid viscera protrudes (which, however, rarely happens, except in shell or other gunshot wounds), the surgeon will be guided by the condition of the protruding part, and the ease of reduction, in his choice between returning it, encircling it with a ligature, or leaving it *in situ*; nor are such cases frequent enough (at least in civil practice) to enable me to lay down any definite rule, but in my own opinion the last course would usually be the best.

Splenotomy.

The removal of the enlarged spleen, when the patient's life is threatened by the symptoms caused by it, has been undertaken many times, and occasionally with success. No precise directions are required for the operation, which is conducted somewhat after the manner of ovariotomy. The dangers, which are very great, depend chiefly on shock and on the possibility of rupture of the vessels in the pedicle before they have been properly secured, as well as on the tendency to secondary hæmorrhage, which is very great in cases of leucocythæmia. It seems that up to the year 1882 the spleen had been removed twenty-nine times—sixteen times for leucocythæmia, and thirteen times for various other morbid conditions. In none of the former sixteen did recovery ensue,[1] while eight out of the latter thirteen survived. No doubt in many of these thirteen cases the operation was superfluous. None of these operations were performed for injury or its results. In twenty-six cases the spleen (or perhaps in some only a portion of it) was removed on account of injury, and of these sixteen survived.

When any part of the bladder protrudes uninjured, a catheter must be passed, and after the bladder has been emptied reduction can hardly present any difficulty.

Wounds with protrusion of wounded viscera.

(*d*) If the omentum protrudes and is injured it should be removed. The solid viscera when protruding may be more or less lacerated, but the treatment of the case is not very much affected thereby. The best plan would be to put on a ligature or clamp tightly enough to restrain hæmorrhage, and leave things to themselves, treating the symptoms as they arise.

But the more common case is where the intestine protrudes and is opened. The prognosis depends mainly on whether any of the contents have escaped into the peritoneal cavity, whether the bowel is lacerated as well as incised, and whether it is or is not entirely divided. In the first case the result must necessarily be fatal, nor do the others leave much hope of survival. If the

[1] Collier, 'Lancet,' Feb. 11, 1882. This author believes that the operation is unjustifiable in cases of leucocythæmia. On the other hand, one of the successful cases, which Dr. Collier classes as one of simple hypertrophy, is described by its author, Dr. Franzolini, as a case of leucocythæmia.—See 'Am. Journ. Med. Sci. Oct. 1882, p. 483.

bowel is lacerated as well as incised its ends must be attached to the wound, and an artificial anus formed,[1] and probably this is also the best course in total division of the gut, though it is certainly justifiable to sew the two portions together with a continuous suture.

But in wounds which affect only a part of the circumference of the bowel, the wound must be united with the continuous suture[2] (just as in a post-mortem examination), the thread divided as near the knot as is judged to be safe, and the suture left to ulcerate through into the cavity of the bowel. While the suture is thus producing the slough of the small portion of the coats of the bowel embraced within it, its material is buried in lymph, which unites the gut either to neighbouring viscera or to the parietes, so that on the fall of the suture no extravasation occurs into the cavity of the peritoneum. The suture enclosing the small slough falls into the intestine and is passed with the fæces. But this reparative action may fail, and on the separation of the suture the contents of the bowel may be extravasated into the peritoneal cavity, or the irritation, instead of producing mere limited peritonitis, which will bury the suture in a circumscribed mass of lymph, may set up diffused inflammation of the whole membrane, and this may prove fatal.

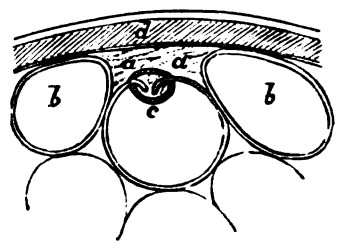


FIG. 70. Diagram of the repair of a wound in the bowel when united by a suture. *a*, *a*, represent the lymph which is effused around the wound, and which glues the wounded part of the bowel, *c*, to the parietes of the abdomen, *d*, or to neighbouring coils of intestine, *b*, *b*, or probably in most cases to both. When the suture separates it falls into *c*, the cavity of the bowel, while the effusion, *a*, prevents the escape of the contents of the bowel into the peritoneal cavity.

Foreign bodies in the viscera.

Foreign bodies which lodge within the stomach or intestines from having been swallowed, are either ultimately voided per anum, or else they make their way by ulceration through the coats of the viscera,[3] and then usually cause death by effusion, or they may lodge in the tube and produce obstruction, or finally they may set up inflammation of the viscus and of the peritoneum without having caused perforation. Mr. Pollock divides these substances into: 1. Round and flat bodies, such as money, fruit stones, bullets, pebbles, calculi. These are generally the least dangerous in their effects; 2. Materials which by accumulation form large masses, such as hair, string, the husk of the oat; such substances constitute the largest foreign masses met with in the food-tube; and 3. Sharp-pointed or cutting bodies, such as pins, fish or other bones, knives. These are generally attended by fatal consequences. The treatment in ordinary cases consists in avoiding purgatives, giving the patient opium, if necessary, to quiet the bowels and alleviate pain, and encouraging him to take a large quantity of bulky, constipating food, hard-boiled eggs, cheese, &c. This is well illustrated by Mr. Pollock from the plan

[1] The subject of artificial anus is treated of in the chapter on HERNIA.

[2] See the diagrams of sutures in the chapter on MINOR SURGERY.

[3] In some cases foreign bodies, commonly pins or needles, are found under the integument, which are said to have been swallowed, and are believed to have travelled out of the stomach or intestine. In those cases where the part in which the substance presents is very far from the stomach, the probability of deception is very great, and it may be said generally that most of such cases are cases of imposition. But some are probably genuine. I once myself removed a crotchet-needle from the epigastrium with the hooked point lying directly under the skin, and from the circumstances of the case, as well as the position of the needle, believed that it had been swallowed. The reader who is curious on this subject will find an interesting paper on it by Mr. Doran in the 12th volume of the 'St. Bartholomew's Hospital Reports.'

pursued by coiners when detected in their attempts to pass false coin. They are usually able to swallow and get rid of even so large a piece as a half-crown, though the attempt is not without its dangers.[1]

Finally, in some few cases, the operation of cutting into the stomach and removing the foreign body may be justifiable, and ten cases at any rate are recorded in which that operation has been undertaken. When the body has passed through the stomach and is lodging in the intestine its removal by operation is a matter of much more doubtful prudence, since even large substances will often ultimately come down to the anus. Yet in the case of a long pointed body, which can hardly be expected to get through the ileo-cæcal valve, the surgeon may feel justified in cutting down on it, where it can be distinctly felt. The bowel must then be drawn to the surface of the wound, opened by as small an incision as possible, the body removed, the wound sewn up, the gut returned into the belly, and the case treated as a wound of the intestine.

There are other, very rare, cases in which a foreign body becomes lodged in the intestine, which has been passed up the rectum, and has from some unknown cause worked its way upwards. I once saw a boy who presented in the right iliac and lumbar regions of the abdomen a long, hard substance which seemed to be a foreign body, and seemed to be lodged in the cæcum and ascending colon. It occasioned little inconvenience. The boy could or would give no history throwing any light on the matter, and the diagnosis could be only conjectural. Ultimately a long piece of wood (I believe the greater part of a cedar pencil) passed from the bowel, which must have been pushed up the anus (though the boy would not admit the fact), since it neither could have been swallowed nor have passed through the abdominal wall. It is also possible that a foreign substance may have passed into the intestine in a gunshot or other wound which has not proved fatal, but such substances will only in the rarest instances lodge in the intestine.

The lodgment of foreign substances in the rectum, vagina, and bladder is common enough. The subject will be discussed in the next chapter.

Gastrotomy.

It remains to say a few words about the operation by which the stomach may be opened, and the indications for it. This operation is properly called *gastrotomy*; but unluckily, in consequence of the identity of the Greek term for the stomach and the abdomen, the same name is also sometimes applied to operations in which the abdomen is laid open, for the purpose either of relieving obstruction or of removing tumours.

Again, the operation of opening the stomach is performed on two different indications: (1) when a foreign body is to be removed, and when the surgeon hopes to restore the patient to complete health; and (2) when through injury to, disease of, or pressure on the œsophagus the patient cannot take food, and the intention of the surgeon is to rescue him from starvation and secure a permanent opening—a sort of preternatural mouth—in the walls of the stomach, through which food is to be introduced so long as the patient lives. The latter kind of operation is now often called Gastrostomy. Such operations are so rare that I must compress what I have to say about them into a very short

[1] See 'Syst. of Surg.' 3rd ed. vol. i. p. 910, where a fatal case is reported in which a half-crown, lodged in the œsophagus, produced ulceration and fatal hæmorrhage from the aorta. Mr. Quain relates one in which a pin which had been swallowed passed through the vermiform appendix into the common iliac artery and caused death.—'Diseases of the Rectum,' p. 326.

space, referring my readers who wish to learn the details of the recorded cases to Mr. Durham's essay in the 'System of Surgery,' or to an interesting article on the subject by Dr. Pooley of New York, in the 'Richmond and Louisville Medical Journal' for April 1875. It is abundantly shown by these papers, which contain all the recorded cases of each kind, that gastrotomy, for removal of foreign bodies, is a very successful operation. Mr. Durham refers to ten cases in which foreign bodies were removed, and out of the whole ten only one died.[1] The analogy also of accidental wounds of the stomach in man, and of cases in which the operation has been performed experimentally on animals, shows that success may fairly be looked for, and would of itself amply justify the performance of the operation in cases where it is clear that the foreign body cannot pass the pylorus, or where its pointed shape or rough edges cause much danger from its sojourn in the stomach. Out of the ten cases the foreign substance was a knife in seven, and a fork in an eighth case.

Gastrostomy, i.e. the opening of the stomach in cases of obstruction of the œsophagus, can only be regarded as a palliative when the disease is malignant; but may afford the patient an indefinite prolongation of life when the obstruction proceeds from traumatic causes, and may as it seems even give time for the cure of the disease when, as sometimes happens, the œsophagus is obstructed from syphilitic stricture. Mr. Durham (op. cit. p. 800) says that he has obtained details of fifty cases of gastrostomy for cancerous disease, of which fifteen died within forty-eight hours, ten others within a week, fourteen others within a month, five others died in three months, and five survived over three months, one being still alive at the time of writing, more than six months after operation. This leaves one case unaccounted for. Out of eleven traumatic cases, death occurred in one on the fourth day from peritonitis and in one on the twenty-eighth day from exhaustion. All the others seem to have done well, and in several cases the power of swallowing was regained to a greater or less extent. In one case under Mr. Davies-Colley's care, where the stricture was syphilitic, the patient entirely recovered, and the gastric fistula was closed nine months after operation.

The operation is generally performed by an incision along the left linea semilunaris—i.e. from the cartilages of the false ribs vertically downwards along the border of the rectus muscle; and the various layers of tissue being carefully divided on a director till the peritoneum is reached and opened with sufficient freedom, the stomach will be easily recognised. Sometimes the omentum has presented, in which case it must be drawn downwards, and the wound extended upwards until the wall of the stomach is exposed. If there be a foreign body in the stomach its projection will, of course, guide the operator. Then the stomach is to be held firmly with catch-forceps sufficiently far out of the wound to avoid all risk of escape of its contents into the abdominal cavity; a vertical incision is to be made just long enough to extract the foreign body, and if the muscular fibres of the stomach completely close this incision after the substance has been extracted nothing further need be done. The viscus is released and the external wound sewn up. Otherwise the wound in the stomach must be united with a fine continuous suture.

When a permanent fistula is to be formed (gastrostomy) the stomach is drawn into the wound, and about a square inch or a little more of its wall is fixed to the wound by means of sutures. Mr. Durham recommends that this be done by two concentric rings of suture, the outer ring passed through the whole thickness of the abdominal wall about ¾ in. from the wound and through

[1] 'Syst. of Surg.' 3rd ed. vol. i. p. 799.

the coats of the stomach, and tied over bougies or buttons on the skin, the inner ring of suture uniting the stomach to the edges of the wound. If the symptoms admit of it, the parts are then to be left quiet for a few (say four or five) days. In more urgent circumstances it may be necessary to make the opening much sooner, or even immediately. It seems better to make the opening very much smaller than used to be the practice. Mr. Durham speaks of an incision about a quarter of an inch long; Mr. Bryant of a mere puncture with a tenotomy knife. The elasticity of the tissues allows a fair-sized tube to be passed through a very narrow opening, and prolapse of the lining of the stomach is thus obviated.

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CHAPTER XIII.

INJURIES OF THE PELVIS.

Contusions and wounds of the buttock.

CONTUSIONS of the walls of the pelvis are very common from the passage of carriage-wheels over the body, from crushes of any kind, kicks, &c., and very large blood-tumours are often seen in the buttock under such circumstances. Many of the recorded cases of gluteal aneurism have been caused by rupture or contusion of the artery against the bone on which it lies. And even when the patient escapes without any serious ill-consequences at the time, yet disease of the bones may be subsequently developed—a malady which is only too frequently fatal. Such injuries should be looked upon with an amount of care proportioned to the violence inflicted; and remembering the frequency with which mistakes have been committed, in taking an old blood-tumour, or, still more unfortunately, a traumatic aneurism,[1] for an abscess, all possible care should be given to the physical examination of tumours in the buttock which follow after contusion. Auscultation and exploratory puncture should never be neglected in cases where any reasonable doubt can exist. It must be remembered that as these extravasations are below the gluteal fascia there is rarely any sign of bruise or injury in the skin.

In wounds of the buttock the chief point is to determine the absence of foreign bodies. I have seen immense pieces of glass and other substances embedded in the buttock and quite overlooked. In deep wounds which penetrate to or near the great sacrosciatic foramen and implicate the large vessels, the surgeon will require all his dexterity and anatomical knowledge in order to secure the gluteal, sciatic, or other wounded artery.[2] Yet, however difficult or severe the operation may be, it is urgently indicated, in order to save the patient from worse dangers. Possibly the application of Lister's tourniquet on the aorta may render the dissection easier and less dangerous, or the common iliac artery may be compressed by a piece of wood passed up the rectum, as practised by Mr. Davy in amputation at the hip.

Fractured pelvis.

Fracture of the pelvis is usually a very grave injury, less, perhaps, on account of the danger involved in the fracture itself—for the bones unite readily—than because of the great violence by which it is usually produced and the risk of injury to the pelvic viscera. There are partial fractures of the pelvis or fractures of the false pelvis which involve little or no danger. Such is the fracture of the anterior superior spine, or of the crest of the ilium, in its neighbourhood, which we meet with occasionally as the result of direct violence. There is pain in the part, and if only the spine is detached it is sometimes drawn down by the tensor vaginæ femoris or the sartorius, but more commonly there is no such displacement. Rest is all that is necessary, and the fracture will give rise to no serious inconvenience. Another fracture, the result of greater violence, such as the crushing of the body against a wall, is

[1] See a paper on the 'Diagnosis of Aneurism,' in 'St. George's Hospital Reports,' vol. vii., and especially the case quoted on p. 181.

[2] A very interesting case of wound of the sciatic artery, and of the subsequent ligature of that vessel, is recorded by Dr. Campbell of Montreal, 'Lancet,' 1862, vol. ii. p. 41.

that which traverses the whole length of the false pelvis or ala of the ilium. This is a more dangerous injury than the former, on account of the possibility of lesion of the intestines which lie in the cavity. I remember well seeing a case in which, after an injury presumably of this kind (for its exact nature was not ascertained), the whole of the fæces were discharged through the outer side of the right buttock, evidently from a bruise or partial laceration of the cæcum, causing afterwards complete perforation of that intestine.[1] The patient ultimately recovered perfectly in all respects. As the viscera are far less closely connected with the false than with the true pelvis, such complications are less to be dreaded in fracture of the former. Fractures of the true pelvis are commonly double or multiple. Very often the two horizontal rami of the pubes give way and the ascending rami of the ischium may be simultaneously fractured, so that the whole of the central part of the pelvis is loose, or the girdle is broken near the sacro-iliac joint on one side, and at the opposite end of the diagonal axis of the pelvis on the other.



Fig. 71. Fracture of the false pelvis irregularly united. The fragments are seen to be a good deal displaced, and at one part, *a*, is a perforation traversing the entire bone. The patient survived six weeks, and it is seen that the fracture is completely, though not firmly, consolidated. Besides this fracture of the false pelvis there was also fracture through the horizontal ramus of the pubes and ascending ramus of the ischium, separating from the rest of the bone the fragment which is absent in the drawing. These fractures were not united, and a small quantity of pus was found between the fragments. The patient, a girl of seventeen, had sustained other severe injuries, and died of pyæmic inflammation of the lungs.—St. George's Hospital Museum, Ser. I. No. 122.

But any kind of multiple fracture may take place, and on the other hand single fractures, as of one pubic ramus or of the ascending ramus of the ischium on one side, from limited violence, are not uncommon, and in these the entire pelvic girdle can hardly be said to be broken. The symptoms are usually unmistakable. In the complete fracture the patient cannot stand, and can hardly make any movement without extreme pain; displacement is easy to ascertain by examination from the rectum and vagina or from the outside, and crepitus can be elicited by grasping the two iliac spines and making attempts at rotation. It is well not to carry these passive movements too far, remembering the serious consequences which may ensue from the displacement of a pointed fragment. In the more limited fractures the symptoms are of course less striking, but there is seldom any difficulty in making the diagnosis.

The prognosis will depend in a great measure on the presence or absence of

[1] Fig. 71 will illustrate the possibility of such lesion of the intestine, by the considerable displacement of the fragments of the ilium, and also the possibility of the discharge of fæces through the bone, by the large perforation in it marked *a*.

visceral lesion. The rectum, bladder, urethra, small intestine, vagina, and perhaps even the uterus, may be wounded by a displaced fragment, or the bladder, if full, may be ruptured by the shock.[1] In the case of the bladder, which is the viscus most commonly injured, the lesion will be testified by blood in the water, sometimes by entire inability to pass water, and the other symptoms of complete rupture. The small intestine is only implicated by very extensive injuries which commonly prove rapidly fatal. If the rectum or vagina be injured the displaced fragment can be generally felt, and there will be bleeding from the part.

The treatment consists merely in complete rest. In the case of children or very restless adults the legs should be tied together, or the patient's movements confined by a broad band pinned to the bed. The body should be so padded as to give the patient comfortable support in an easy position. If displaced fragments can be felt from the bowel or vagina they must be replaced if possible, for which purpose an anæsthetic is to be given. Nothing further is required

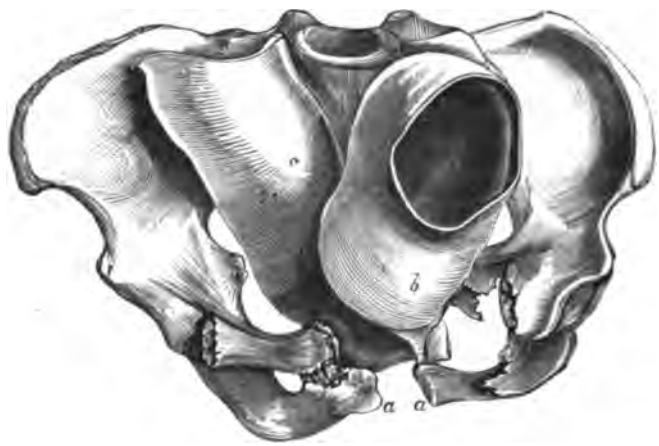


FIG. 72. Compound comminuted fracture of the pelvis. The patient, a boy æt. 5, died next day, having received other severe injuries. *a*, *a* shows a separation of the symphysis pubis, which communicated with a deep wound passing down on the right side of the bladder, *b* (which was extensively separated from its connections on the right side, but was not lacerated), to the front of the rectum, *c*. The sphincter ani was partly torn on its anterior aspect, and there was bleeding from the anus; but the bowel was not further injured. The right pubic ramus is seen to be comminuted, separated from the ilium, and fractured at the crest of the pubes. There was also partial separation of one sacro-iliac synchondrosis.—St. George's Hospital Museum, Ser. i. No. 119 b.

beyond attention to the state of the bowels, catheterism if necessary, and a watchful vigilance as to the formation of matter, which should be at once evacuated. Probably in about six weeks[2] or two months, if all goes well, the patient will have recovered the power of standing, and when this is the case, but not before, he may be allowed to leave his bed. It is much better to keep him in bed longer than may be absolutely necessary, rather than to risk any relapse by too early disturbing the injured parts.

Dislocation of the pelvis.

There are various other fractures which are more rarely met with, and to which our space will only permit a very short reference. Sometimes the line of fracture traverses the pubic symphysis (fig. 72), i.e. in strictness of speech, the two ossa pubis are dislocated from each other; and dislocation, more or less complete, of the sacro-iliac joint may also happen, though generally it is only a

[1] In rare cases some of the large nerves may be injured. The Museum of St. George's Hospital contains a specimen (Ser. i. No. 119) of fracture of the ramus of the pubes, in which the obturator nerve was injured. The patient died of tetanus.

[2] Fig. 71 shows how far repair may have advanced in six weeks, in early life.

complication of more extensive injury.[1] As in the analogous case of the spine, the surgical considerations applicable to these dislocations differ in no respect from those of fracture in the immediate neighbourhood, with which, indeed, they are usually associated.

Fracture of the acetabulum.

Again, fracture may originate in the acetabulum. It is not rare for an extensive fracture, starting from any part of the pelvis, to traverse the acetabulum, and such fractures, as in two beautiful specimens figured by Mr. Birkett,[2] may unite quite kindly, though probably not without shortening of the affected limb. But the injuries which are described as fractures of the acetabulum are twofold. One is a fracture of some part of the lip of the acetabulum, and this is believed to occur either with or without dislocation of the hip. I saw a case once of dorsal dislocation in which all the symptoms were strongly confirmatory of the diagnosis of fracture of the acetabulum. The dislocation was reduced without difficulty, and nothing peculiar was noticed, but on visiting the patient next day the surgeon was surprised to find that it had been reproduced. It was again reduced, but the reduction was found to be quite insecure, for it slipped out as easily as it was put in. And now it was thought that crepitus could be detected. The limb was put up as carefully as possible, but I believe that some deformity persisted. Fracture of the lip of the acetabulum without dislocation was believed by Mr. Benjamin Travers, jun.,[3] to be the injury in some of those cases in which, without any proof of fracture of the neck of the femur, the upper end of the bone becomes afterwards changed in shape, so that shortening gradually comes on; but the truth of this opinion has not as yet been proved. One of Mr. Travers's cases was obviously an instance of chronic rheumatic arthritis complicated with a contusion.

Impaction of the head of the femur in the acetabulum.

The acetabulum is sometimes driven in by the forcible impaction of the head of the femur in falls on the trochanter, and this impaction in a celebrated case related by the late Mr. Moore ('Med.-Chir. Trans.' vol. xxxiv.) had been so complete that the whole of the head of the femur had passed into the inside of the pelvis; yet the patient recovered. A few similar cases are recorded, though none, as far as I know, in which the impaction was so complete as this. The diagnosis from fracture of the neck of the femur is very difficult. The only case which I have myself seen was taken during life for an impacted fracture of the cervix femoris; but it is fair to add that the surgeon under whose care the patient was thought it better to abstain from any rigorous examination.[4] If the head of the femur were completely wedged into the pelvis, as in Mr. Moore's case, I presume that, under chloroform, the complete immobility of the femur and the absence of any sign of dislocation would enable the surgeon to make at any rate a conjectural diagnosis; and if the impaction were incomplete possibly crepitus might be obtained, and might be felt also in other parts of the pelvis, but I am not aware that any case of the kind has ever been minutely examined, nor is it, perhaps, justifiable to do so. Hence the diagnosis is as a rule only conjectural. As the treatment is exactly the same as for impacted fracture of the cervix femoris, this is a matter of no importance.

Lastly, the coccyx may be fractured or dislocated. This is commonly the

[1] In the 'Brit. Med. Journ.' for July 6, 1878, may be seen an interesting case, related by Mr. Thoresby Jones of Chatham, of pure dislocation of the sacrum forwards, proving fatal by injury to the left external iliac vein.

[2] 'Syst. of Surg.' vol. i. pp. 916–17, 3rd ed.

[3] 'Further Observations in Surgery,' 1860, p. 27.

[4] The preparation is in the Museum of St. George's Hospital, Ser. i. No. 123.

Fracture and dislocation of coccyx.

result of direct violence, though it is said to have taken place also in parturition. The pain in the part, felt especially in sitting, and the result of exploration from the skin and from the bowel, will easily settle the diagnosis. Reduction can be accomplished by pressure and counter-pressure from the skin and rectum, and the patient must be kept at rest till movement is no longer painful.

Rupture of the bladder.

One of the most formidable consequences of contusion of the pelvis or lower part of the abdomen is rupture of the bladder. This occurs in both sexes, but is much more common in the male. The bladder may also be perforated by one of the fragments in fracture of the pelvis, or may be ruptured in fracture of the pelvis without any perforation. The symptoms of rupture of the bladder, when uncomplicated by fracture, are generally quite unmistakable. The patient loses at once all power of expelling urine, and when the catheter is passed, which is unattended with any difficulty, the bladder is found perfectly empty, or only a few drops of bloody fluid are drawn off. Frequently, on passing the catheter further, a large quantity of urinous fluid is drawn off from the cavity of the peritoneum.[1] There is frequently severe pain and collapse, but often also there is no collapse and but little pain.[2] Sooner or later, however, the usual symptoms of peritonitis will come on, and then the patient will probably sink.

Two or three questions of interest present themselves in connexion with the subject of traumatic rupture of the bladder. First, as to the diagnosis. This, as I said above, is usually unmistakable. After a severe blow the patient immediately loses all power of passing water. It may be merely retention from shock, following on the contusion ; and temporary retention from a blow on the abdomen is common, as it is also after surgical operations on the abdomen. But then the catheter will draw off a quantity of urine proportioned to the period of retention ; and this urine will be free from blood, unless the kidney is bruised. Or it may be a case of laceration of the urethra, but then there will be considerable difficulty in introducing the catheter ; and if the catheter can be passed the bladder will be found full of healthy urine. There are, however, some cases in which the exact nature of the injury remains obscure. They are chiefly those in which the laceration affects the extra-peritoneal portion of the bladder, and where the urine, not finding so free an exit as it does when the rupture passes into the peritoneal cavity, the bladder preserves some power of retaining, if not of expelling, the urine. But there are other cases in which somewhat similar symptoms exist, though the laceration extends into the peritoneum.[3] In one such case I suspected that the laceration had at first been incomplete, and that the rent afterwards gave way ;

[1] Mr. Willett and Mr. C. Heath have remarked, as an aid to diagnosis, that when the catheter is introduced through the ruptured bladder into the peritoneal cavity, the flow of urinous fluid is more directly under the influence of the movements of respiration than it ever is when the bladder is not ruptured.

[2] I well remember the case of a man who applied at St. George's Hospital on a Monday morning, having received a rupture of the bladder on the previous Saturday evening from a blow or fall when fighting. He walked to the hospital and displayed no distress of any sort, except some pain in the part which had been struck, though on post-mortem examination the bladder was found extensively lacerated and communicating freely with the peritoneal cavity.

[3] See a very characteristic case in Le Gros Clark, op. cit. p. 333, in which six or eight ounces of bloody urine were drawn off by the catheter, and the patient several times passed urine; nevertheless there was a laceration of the bladder an inch in length communicating with the peritoneal cavity.

but others are not susceptible of this explanation. The complete discussion of the subject would lead us too far in treating of what are, after all, very exceptional injuries. Another very interesting question is the possibility of recovery after traumatic rupture of the bladder; and this is obviously connected with the situation of the rupture. If the rupture be entirely extra-peritoneal there is no intelligible reason why recovery should not ensue; and one case is recorded in which this injury, complicated with fracture of the pelvis, terminated in recovery.[1] But, as a general rule, in rupture from contusion, the bladder gives way at its upper part, and the rent extends freely into the peritoneal cavity. Is such an injury necessarily fatal? I confess that I think not. If, indeed, we believe that the urine has some necessarily poisonous properties, its free admission into the peritoneal cavity must, of course, prove fatal. But this seems rather assumed from the analogy of the effects of extravasation of urine in stricture than proved by observation of cases of ruptured bladder. I have already referred to a case in which there were no symptoms of any urgency, though the urine had been admitted to the peritoneal cavity for a period of thirty-six hours at least. And I may remark, that though the extravasation of putrefying urine will rapidly destroy the cellular tissue, yet the constant exposure of transplanted flaps in the operation for extroversion of the bladder to the contact of healthy urine is not inconsistent with their nutrition and rapid union. I am glad to be able to refer to the high authority of Mr. Le Gros Clark in support of the doctrine 'that in some instances the presence of urine seems to be tolerated almost passively by the serous membrane,' and that 'it seems not improbable that urine may be absorbed by the peritoneum' (op. cit. p. 341). If we believe this, it seems reasonable to take a somewhat more hopeful view of this injury than has prevailed as yet, and to enquire whether something might not be done for its relief. The usual practice is to subdue the pain by opium, and to draw off the water, if possible, as it comes into the bladder by tying in a soft catheter, the eye of which is believed only just to lodge within the viscus. But this practice has obviously no curative effect, and the bladder in these cases is usually so collapsed that it is impossible to be sure that the catheter is not lodged in the peritoneal cavity, in which case it would effectually prevent recovery. The methods of treatment recommended in rupture of the bladder may be classed as three in number: 1. Direct incision into the peritoneal cavity, washing out the effused blood and urine, and sewing up the rent. This has been done twice; viz. by Mr. Willett ('St. Barth.'s Hosp. Reports,' vol. xii.) and Mr. C. Heath ('Med.-Chir. Trans.' vol. lxii.), in neither case with success; but in both cases too long a period had elapsed after the accident to give the operation a fair chance. Yet in Mr. Heath's case the immediate benefit was very striking, and the fatal event seems very certainly due to the slipping of the suture. I believe that this operation is justifiable and may be successful if performed soon after the accident, and when the symptoms clearly point to a free laceration into the peritoneum. The main objection is the difficulty in applying the suture. 2. A free incision may be made from the perinæum, as in lithotomy, and the bladder drained of the urine as fast as it comes in, the powers of nature being trusted to absorb and get rid of the urine already poured into the peritoneum. One case seems to have recovered under this treatment (Mason's case, quoted by Messrs. Willett and Heath). 3. The

[1] Rhynd, 'Path. and Prac. Obs. on Stricture,' quoted by Birkett, 'Syst. of Surg.' 3rd ed. vol. i. p. 920.

peritoneal cavity may be washed out, either by passing a catheter through the urethra, or through a wound in the perinæum, the washing out of the serous cavity being carried on as often as the symptoms seem to call for it. Two cases (Chaldecott's and Thorp's) are on record in which patients recovered after the evacuation of the urine out of the peritoneal cavity through the urethra, and in Thorp's case the peritoneum was also washed out on one occasion with three several injections of eight ounces of warm water. The washing out of the peritoneum would be still more easy through a perinæal wound; but this treatment seems to be still untried.

Now that we no longer regard rupture of the bladder as a necessarily fatal accident, even when the rupture involves the peritoneal cavity, I have no doubt that the accident will be treated with occasional success by any of these methods.

Another very formidable lesion in contusion of the pelvis is laceration of the male urethra, which, though seldom directly fatal, produces often the most formidable kind of stricture, and thus frequently proves fatal indirectly or condemns the patient to a life of misery. The injury occurs from a fall, blow, or kick on the perinæum, by which the urethra is caught between the contusing force and the pubic arch, and is lacerated just in front of the prostate gland. The laceration may be total—and probably it is so generally—but in some cases a portion of the tube remains entire, as I have known verified by dissection. There is often some bruising in the perinæum, though this is by no means necessarily the case. If the patient has been neglected the urine may be extravasated, and after a time the skin will slough—and I have known this sloughing assume considerable proportions—but usually either the patient passes no water for some time after the injury, or it produces no deleterious effect, for such inflammation and sloughing is not very common. The passage of a catheter reveals at once the nature of the injury. The point of the instrument passes into a cavity at the part mentioned (i.e. just below the pubes); and this cavity is often of large size, containing a good deal of bloody, urinous fluid. It is sometimes possible to pass the catheter into the posterior end of the urethra, and reach the bladder; and when this is done healthy urine is drawn off. The instrument may then be tied in, and the surgeon may wait for any subsequent inflammation or effusion, when free incisions are to be made. Usually, however, it is found impossible to reach the bladder thus. The patient must then be anæsthetised, put up in the lithotomy position, and an incision must be made through the whole raphe of the perinæum, extending freely into the above-mentioned cavity. If other parts of the perinæum are swollen and inflamed, incisions ought to be made into them. As to passing a catheter into the bladder the views of surgeons differ. A free incision into the perinæum is doubtless all that is necessary for the moment. The urine will escape through the wound, and the patient—who is generally a lad or a healthy young man—will in all probability recover. As the parts consolidate it will become possible to pass the catheter, and for a time all will be well. On the other hand, the retention of a catheter in the bladder may occasion a good deal of irritation, and it may be necessary on that account afterwards to withdraw it. All this I admit; and on these grounds many of the best authorities dissuade any attempt to reach the bladder and leave a catheter in it. But it seems to me that if the catheter can be passed at first, and if the patient can bear it to be left in the bladder (which I know by experience that he very often can), the wound in the urethra unites much more kindly, and with far less tendency to that subsequent cicatricial contraction which is

so painful a sequela of these contusions.[1] In any case the patient must be warned that it is only by the constant passage of the catheter after recovery, and that for an indefinite period, that he can hope to be free from the painful consequences of cicatricial stricture, which is the worst form of stricture, rapidly contracting till the passage is almost closed; peculiarly liable to be complicated with fistula in perinæo, and often so tight and irritable as to cause much difficulty and pain in passing the instrument. Further observations on the treatment of cicatricial stricture will be found in the section on STRICTURE.

Wounds and other injuries of the perinæum and male organs.

Contusions and wounds of the scrotum are comparatively common. Extravasation produces a large ecchymosis, the colour of which is generally perfectly black. But it is rarely followed by consequences which can be regarded as at all serious, unless it is complicated by rupture of the urethra and extravasation of urine, when there may be extensive sloughing. Again, wounds of the scrotum are sometimes lacerated to a very great degree. The whole scrotum may be torn off, and the exposed testicle or testicles may either be implicated in the injury or not. There are also wounds inflicted in attempts at self-mutilation in which the parts may be very freely removed. I was once called upon to treat a lunatic who had completely removed the whole of the generative organs—penis, scrotum, and both testicles[2]—leaving only about a quarter of an inch of the penis. He recovered without any bad symptoms. Other injuries of the penis are rare, on account of its mobility and usually flaccid condition. All such wounds are to be treated on general principles. They are remarkably prone to rapid union and complete repair. It is singular to observe how completely the new tissue will cover the exposed testicles, and how well the cicatrix will replace the lacerated and removed scrotum. The testicle, though so exquisitely sensitive to contusion or pressure, is singularly indifferent to wounds, and has often been punctured by mistake in the operation for hydrocele, or incised in treating orchitis, with perfect impunity. In the instance above referred to nothing was necessary except to tie one of the spermatic arteries, the other having ceased to bleed, and the patient recovered rapidly under the use of simple water-dressing. But whenever the urethra is divided it is necessary either to keep a catheter in the bladder while it is healing, or to pass the instrument frequently; and if the penis is cut off the same precaution should be adopted as after amputation of the organ, viz. to keep the urethra permanently open by slitting it up and attaching the mucous membrane to the skin (see AMPUTATION OF THE PENIS). The most troublesome cases are those of wounds of the corpora cavernosa, which are apt to be followed by very distressing erections and by deformity of the organ. All wounds of the male organs of generation require very careful adaptation by means of sutures. And in wounds of the scrotum the extremely retractile nature of the dartos should be remembered. The testicles may be most freely exposed, and the surgeon be tempted to believe that the scrotum has been almost torn off, yet if the part be relaxed by the application of warmth and moisture for an hour or two, he may find that there is really little if any loss of tissue, and that the scrotum can be perfectly adjusted; and in such injuries

[1] I once saw a man who had been under my care about four years previously, and who had been treated by introducing and tying in a large catheter from the first, i.e. from the original operation of dividing the perinæum. He had remained quite free from any trouble, and still passed No. 10 catheter at intervals with perfect ease.

[2] The parts are preserved in the Museum of St. George's Hospital, ser. xiii. No. 1.

if the spermatic cord is severed Mr. Birkett believes that its repair is not impossible, if the ends of the vas deferens are united by suture. At any rate the attempt seems worth making.

The painful consequences of contusion of the testicles are best combated by complete rest, supporting the testicles in some soft substance with warmth and moisture. If the patient suffers severely morphia should be injected subcutaneously.

Ligature round the penis.

Another injury which we meet with sometimes is that in which children in play, or sometimes in fright from having been beaten for wetting the bed, tie a string tight round the penis. The nature of the case is known at once by the swelling of the front part of the organ, and the deep groove seen behind the swollen part. Anæsthesia should be at once induced, and the string carefully divided on the dorsal aspect of the penis and removed. If this is not done I have seen the urethra, and in one case nearly the whole penis, cut through by the ligature, causing irreparable and most painful deformity.

Injuries of the external female organs.

Injuries of the labia and female perinæum from blows and kicks are common enough. The ecchymosis, as in the scrotum, is usually abundant and very dark-coloured. The skin may be more or less lacerated, and sometimes the perinæum may be slightly torn, but it is very rare for any serious laceration of the perinæum to be caused by a wound.[1] Nor are the consequences of contusion usually serious. If neglected, abscess may ensue, so that rest is to be enjoined, and the application of an icebag or evaporating lotion is generally advisable at first, in order to check the extravasation. Afterwards warm fomentation is more soothing and grateful.

Wounds of the vulva may involve the vagina to a greater or less degree or may pass into the rectum or bladder, or the vagina may be torn in coitu;[2] but the vagina is more often wounded by the unskilful use of instruments in delivery, or by bungling attempts to procure abortion. The latter cases hardly fall within the surgeon's province. The main point to bear in mind in the treatment of wounds of the vagina is the probability of contraction from cicatrisation, and the great difficulty and pain which this will produce in sexual intercourse. So that all possible care should be used to maintain dilatation of the vagina during the union of the wound, and for some time afterwards.

The unimpregnated uterus is so small, so hard, so movable, and in so remote a situation that it can hardly be wounded except in complicated injuries in which this would be quite a subordinate feature. And the injuries of the pregnant uterus seem better left to works on obstetrics, since they could hardly be treated of adequately here. They are rarely the result of mere accident, but constantly occur in criminal attempts to produce abortion, and sometimes in unfortunate instrumental delivery, with or without want of skill. For a comprehensive account of the surgical aspects of these cases the reader is referred to the account by Mr. Birkett and Dr. Braxton Hicks in the 'System of Surgery,' 8rd edition, vol. i. p. 935 and sqq.

Either the rectum or the bladder may be penetrated by a wound. In the male sex the bladder can only be wounded through the abdominal wall or the

[1] I do not here speak of injuries to the external parts in criminal assaults, as this subject is best treated along with the questions of medical jurisprudence. The surgical injuries so inflicted are trivial.

[2] St. George's Hospital Museum, Ser. xiv. No. 108.

rectum, but in the female it may be punctured through the vagina.[1] In all such cases as those last mentioned the greatest care should be taken to sew up the wound at once, and keep a catheter in the bladder, when the wound will probably heal, if its edges are clean cut. In stabs of the bladder from the abdomen the risk of extravasation of urine is great, and they are very often fatal, and this danger is, of course, greatly increased when the peritoneal cavity is also implicated. I think it is usually desirable in wounds of the bladder to keep the viscus emptied by means of a catheter tied in, though on this subject the surgeon must use his own discretion, remembering the risk of lodging the point of the instrument in the wound. In other respects no treatment can be applied, except that which may be demanded by the symptoms.

Wounds of the rectum.

Wounds of the rectum are produced usually by falling on a stake or railing. They are not generally fatal, and if not fatal they lead to no serious consequence. I am not aware that any case is recorded in which contraction of the bowel has been thus produced. But when the stake or other weapon has passed far in it may lacerate the peritoneal cavity, or the great vessels in the pelvis, or the bladder. The first-named injury may be regarded as inevitably fatal, and the second will probably be so. Of the third two cases are recorded,[2] one of which survived. No special treatment can be adopted in any of these forms of injury.

Foreign bodies in the bladder and other pelvic cavities.

Foreign bodies may be introduced into the male or female urethra or bladder, into the vagina or rectum. They may also lodge in any of these situations in cases of wounds, but this is most common in gunshot wounds; and as the surgical considerations are the same in all such cases the reader is referred on that head to the chapter on GUNSHOT WOUNDS.

Foreign bodies lodged in the male urethra may commonly be extracted with the forceps, since they lie generally very far forward, and must be smooth and rounded, or they would not be introduced. But in some cases fragments of bougies or of other substances introduced may break off in the deeper parts of the urethra beyond reach of the forceps. The best plan then is to try and push the substance back into the bladder, and break it to pieces, or, if small, remove it entire with the lithotrite. If this is impossible, the foreign body must be cut down upon from the middle of the perinæum and extracted. Of the foreign substances which are lodged in the male bladder a fragment of an old worn-out bougie or gum-catheter is by far the most common, and these can usually be caught in a lithotrite, and if small extracted entire, while if of large size they can be cut to pieces and will pass of themselves. If the substance cannot be caught, or is too hard or too large to break, it must be extracted by lithotomy, and lithotomy in such cases is far more successful than in cases of stone, since the urinary organs are probably healthy. One of the most troublesome foreign bodies to deal with is a hairpin in the female bladder. It is not at all uncommon for the pin to be passed up the urethra, of course with its bend towards the bladder, and then to slip into the bladder and expand, its points sticking into the mucous membrane, and awkward attempts at extraction

[1] In the section on vesicovaginal fistula will be found a reference to a singular case, in which that infirmity was caused by the passage of a pistol-bullet from the vulva through the vagina into the bladder.

[2] By Mr. Prescott Hewett, 'Path. Soc. Trans.' vol. i. p. 152; and by Mr. Buée of Slough, 'Syst. of Surg.' 3rd ed. vol. i. p. 924.

will aggravate the mischief. The best treatment is to dilate the urethra sufficiently to introduce the finger, when the foreign substance may be dislodged, or be drawn down by a hook passed round its bent end, or its two points may be brought together and a tube or forceps applied round them.

Foreign bodies are sometimes passed into the vagina, and the patient is unable to extract them, and will not apply for relief till they have occasioned much mischief. I once saw a case in which the end of a phial was lodged in the vagina, and had made its way by ulceration into the bladder, causing a most formidable and perfectly incurable form of vesicovaginal fistula. It is not uncommon for the string of a pessary to break, and the substance to be left in the vagina till it becomes very foul and offensive. All such foreign bodies should be removed at the earliest possible moment, under anæsthesia if necessary.

Foreign bodies in the rectum may be of very large size, but there is no difficulty whatever in extracting them under chloroform after dilatation of the anus; or if the surgeon judges it better they may be broken up, as is usually done with the hardened lumps of fæces which sometimes obstruct the lower part of the bowel. This can be effected with the handle of a spoon or with a lithotomy scoop. Harder substances may require a strong pair of forceps, or even cutting pliers. But in all cases the extraction of sharp-pointed fragments at once is imperative.

CHAPTER XIV.

INJURIES OF THE UPPER EXTREMITY.

ALL injuries of the shoulder, arm, forearm, or hand are less serious than the similar injuries of the hip, thigh, leg, or foot. The main reason of this is no doubt the freer supply of blood to the part; but even irrespective of this there is a specific difference in the effects of disease on the two limbs respectively. Thus gangrene of the arm is of far less consequence than of the leg, and a wound implicating the shoulder does not involve anything like the same danger to life as one of the hip.

Again, the fact that injuries of the upper extremity do not necessitate confinement to bed or to the house renders them in many respects less depressing than those of the lower.

From these and such-like considerations it results that the surgeon may venture on attempts to preserve the upper limb in traumatic injuries, or in lesions from disease, which in the lower limb would imperatively call for the removal of the diseased part; that when the diseased part must be removed he may venture on operations of excision or resection which would not be justifiable in the lower limb; and that even when he knows the parts to be damaged beyond the possibility of repair he may often think it the best course to wait for gangrene rather than remove any part which might ultimately recover itself.

And for the same reason minor injuries are susceptible of more active treatment in the upper extremity, because the surgeon is less apprehensive of the occurrence of suppuration from too early use of the part, or from friction or passive motion, and less apprehensive also of its results if it does occur.

Foreign bodies.

Foreign bodies (thorns, needles, &c.) often lodge in the palm. They are frequently hard to detect, since a piece of indurated tissue may be mistaken for the end of the needle. Unless the patient is suffering much inconvenience, it is a good rule not to cut down on a supposed needle in the hand or foot without being able to feel both its ends. In some of these cases the point can be thrust through the skin without any incision.

Wounds of the palmar arch.

Wounds of either palmar arch are frequently troublesome in their treatment and dangerous in their results, in consequence of the very free anastomosis which takes place between the two arteries which form either arch. The superficial arch, it is true, is much less deeply situated, and, when wounded, it can be reached and secured, without wounding any other important structure, provided the patient be seen soon after the injury; but then, very frequently this is not the case; on the contrary, the parts have become so infiltrated with blood that it is impossible to find the bleeding orifice. And when the deep palmar arch is wounded its position beneath the great nerves and tendons renders it difficult to tie it without very serious injury to the structure and functions of the hand, even irrespective of any infiltration of blood.[1]

[1] The deep arch may, however, be reached from the dorsum of the hand, by an incision running along the radial border of the first metacarpal bone, and dividing the origin of the first dorsal interosseous muscle from that bone, the parts being rendered bloodless by Esmarch's

In these injuries the first object of the surgeon is to stop the bleeding long enough to allow the wound in the artery to close, and this can generally be done by careful pressure with pad and bandage,[1] assisted by the raised position of the hand, or by acute flexion of the elbow, whereby the brachial artery is compressed against the coronoid process, or by graduated pressure on the radial and ulnar arteries, or by a combination of the last with one of the two former methods. Such compresses, when once applied, should not be moved for several days, unless from absolute necessity.

Professor Vanzetti has lately suggested a method which he calls 'unci-pression,' i.e. the pressure of a single or double hook on either lip of the wound, as described on p. 98, which seems especially suitable for these wounds of the palm, since it makes constant pressure on the bleeding orifice, without giving pain or producing either œdema or sloughing, symptoms which often necessitate the removal of the compresses applied to the wound.

If the bleeding cannot be thus suppressed by pressure in and above the wound two courses are open—viz. either to tie both arteries of the forearm just above the wrist, or to tie the brachial artery at once. Like all operations in which an artery is tied higher up, in order to stop hæmorrhage from a wound below, both these methods of treatment are uncertain. The weight of authority seems, however, to be in favour of the ligature of the brachial at once, rather than that of the two arteries of the forearm. Ligature of one of the latter without the other appears nugatory. In some cases it has been deemed necessary to amputate the hand in order to save the patient from death by hæmorrhage; but I would repeat that careful plugging and pressure on the wound, immediately after the injury, will generally stop the hæmorrhage, and render all ligature of the arteries unnecessary.

Suture of divided nerves and tendons.

In wounds of the hand and wrist it is very common for the large nerve-trunks and the tendons to be divided. The subject of nerve-suture will be referred to in the chapter on AFFECTIONS OF THE NERVES. Here it will be sufficient to say, that in all cases where the large nerves (e.g. the median or ulnar) are seen to be divided, their ends should be gently drawn together and united with one or two fine sutures. It seems also that the same treatment may be successfully applied to divided tendons. The retraction of the ends of the tendon renders it improbable that union will occur spontaneously, while, if they are drawn into place and united with carbolised catgut, they have been known to recover their functions.[2] The wound must be enlarged sufficiently to enable the operator to recognise the sheath of the tendon, which is then to be slightly incised, the ends of the divided tendon brought gently into apposition and secured with one or two sutures, and the limb put up in such a position as to relax the parts as much as possible. Every effort should be made to secure rapid union; pus, if it forms, should be at once evacuated, and passive motion commenced as soon as the wound has healed.

Fractures of the clavicle.

The clavicle may be fractured in any part of its extent, but the middle of the bone is that in which fracture is by far the most common. The accident almost always takes place from indirect violence, i.e. from a fall on the hand or on the point of the shoulder. The common fracture of the clavicle is easily

bandage. Dr. Ogston of Aberdeen performed this operation in a most interesting and successful case, reported in the 'Brit. Med. Journ.' June 24, 1876. But this would only be practicable when the palmar arch is wounded close to its origin.

[1] A good way of securing these pads is to make pressure on them with a splint in front, which is connected with and supported by another splint behind the hand.

[2] See a paper by Dr. Chambers, of Indiana, in the 'Indiana Med. Journ.' Sept. 21, 1882.

recognised in most cases by the characteristic displacement. The bone gives way at its most curved point. The outer fragment, to which the whole weight of the arm is now connected, falls downwards, and is possibly drawn down also by the muscles which pass from it to the arm. It is also almost always tucked inwards below the inner fragment by the action of the flaps of the axilla, or by the impulse of the fall, or by both. The inner fragment is believed by some surgeons to be raised by the sternomastoid muscle, but this seems unlikely, as the attachment of the rhomboid ligament is sufficient to prevent any such displacement.[1] No doubt, however, the displacement in this, as in all other fractures, depends a good deal on the direction of the line of fracture, and accordingly we see specimens in which the outer fragment lies on the same level, in front or behind the inner, and even above it.

This fracture is very rarely compound, and it is very rare for any serious complications to accompany it. But the nerves of the brachial plexus, or one of the large bloodvessels may be injured. There is a specimen in the Museum of St. George's Hospital, showing the internal jugular vein punctured by a fragment of the clavicle, and Sir Robert Peel's death was produced by a somewhat similar injury. In some very rare cases of direct violence both clavicles are fractured simultaneously.

The fracture is susceptible of very complete repair, and in cases where there has been no displacement this will be unaccompanied by any deformity; usually, however, considerable displacement remains during life, though it entails no ill effects beyond the slight disfigurement. The periosteum appears to be often untorn, especially in early life, and possibly in some of these cases the fracture may have been incomplete, or of the 'green stick' variety, as shown in the figure on p. 112.

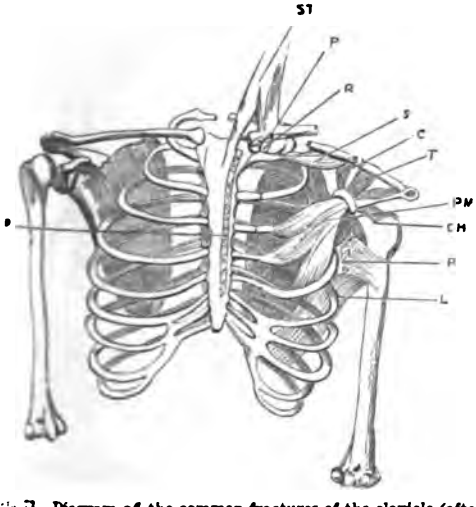


Fig. 71. Diagram of the common fractures of the clavicle (after Hirst, modified). ST. Sternomastoid muscle. PPP. Pectoralis major muscle. PM. Pectoralis minor muscle. S. Subclavius muscle. L. Latissimus dorsi muscle. C. Conoid ligament. T. Trapezoid ligament. CH. Coracohumeral ligament. R. Rhomboid ligament. A fracture is shown in the usual position, and with the usual displacement—the outer fragment downwards and inwards—and the muscles are shown to which that displacement is generally attributed. Another fracture is shown between the conoid and trapezoid ligaments, and this fracture is shown as not being displaced, according to the general opinion.

The method of union is often by an exuberant or provisional callus. The period of union is from three to four weeks, after which no apparatus is necessary, though it is prudent for the patient to carry his arm in a sling for a time. The number of different contrivances for the treatment of fractured clavicle testifies to the difficulty of keeping the bones in contact, and, in fact, it is always proper to prepare the patient's mind for the continuance of deformity. The old plan attempts to fulfil three indications: 1. Reduction is effected by drawing both shoulders backwards and raising the affected shoulder by the hand in the axilla, the surgeon standing behind the patient,

[1] See, however, a case related by Mr. Hulke, in which the sternal fragment was raised up at an angle of 45°. 'Syst. of Surg.' 3rd ed. vol. i. p. 948.

and pressing his knee between the scapulæ. To remedy the displacement of the outer fragment inwards, the shoulders are then kept back by a figure-of-8 bandage encircling both axillæ and crossing behind. 2. Before applying the bandage a thick pad is placed in the axilla, in order to raise the shoulder and prevent the displacement of the outer fragment downwards. 3. Next, in order to obviate the tendency to loosening of these bandages, the arm and hand are encircled and bound to the chest by a broad bandage, which also fixes the scapulæ. All the turns of the bandage should be stitched together, or painted lightly with starch. This apparatus, however, can never be kept satisfactorily in position, and many surgeons object (and, I think, with reason) to the figure-of-8 bandage as liable to press on the outer fragment and displace it. A good and convenient plan is to put a short crutch into the axilla, which is fixed by a strap going across the opposite shoulder, and another round the

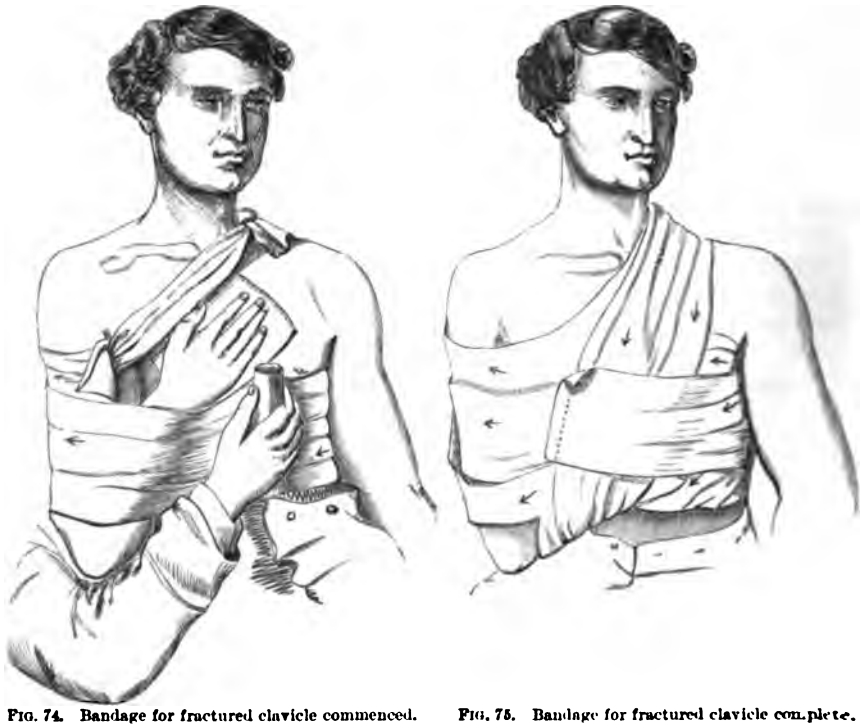


FIG. 74. Bandage for fractured clavicle commenced. FIG. 75. Bandage for fractured clavicle complete.

body, and to carry the arm in a sling. Some surgeons recommend that the hand should be raised and bandaged on to the opposite shoulder.[1] A very good result may be obtained by perfectly reducing the fracture, and keeping the patient at perfect rest in the supine horizontal posture, any accidental fresh displacement being at once remedied. But very few persons, except young ladies careful of the future appearance of the neck, or persons laid up by other injuries, could be persuaded to submit to such an irksome treatment in order to avoid the very trifling deformity left by the fracture, since no real inconvenience results from it. Dr. Gordon combats the general views with regard to the cause of the displacement which is generally found in fracture of the clavicle. In the first place, he says, as I have also said above, that the direction of this displacement must depend mainly on the course which

[1] Bryant, 'Practice of Surgery,' 2nd ed. vol. ii. p. 375.

the line of fracture takes. In the next place, the ordinary displacement in which the inner end of the outer fragment lies below and internal to the outer end of the inner piece, is due, according to him, chiefly if not solely to the rotation of the scapula forwards and inwards—a rotation caused, as he believes, mainly by the action of the serratus magnus and the pectoral muscles with the assistance of the subclavius. The depression of the affected shoulder he believes to be apparent only (or if real very slight) and due almost entirely to an inclination of the spine in sympathy with the rotation of the scapula. As to treatment, he regards elevation of the shoulder as worse than useless, since pressing the humerus up in the joint will tend to increase the rotation of the scapula and thus the displacement of the outer fragment. He teaches therefore that the essential indication of treatment is to carry the scapula outwards and backwards, and fix it in that position till osseous union has taken place. This is accomplished by an apparatus consisting of a shield applied to the thorax (and secured by straps round the uninjured shoulder) carrying a rod, or artificial clavicle, as he calls it, which can be lengthened or shortened by means of a screw. At the end of the rod is a splint of metal to embrace the upper arm. The arm is driven outwards and backwards by lengthening the rod, and is further rotated outwards by properly padding the splint,[1] and thus the scapula is acted on, and the proper length of the clavicle restored. I agree in Dr. Gordon's views to a great extent. At any rate I think if the surgeon will take the pains to put the spine quite straight, he will see that in most cases the drooping of the shoulder is, as Dr. Gordon says, more apparent than real, and the arguments which Dr. Gordon uses to show that elevation of the shoulder must increase instead of diminishing the displacement are at any rate very striking. I have used his apparatus with at least as good results as any other, and he himself reports that the results he attains are much superior. The inconvenience, however, which the persistence of the deformity causes is so slight, that it will be long before the use of an expensive apparatus becomes common in our out-patient rooms.

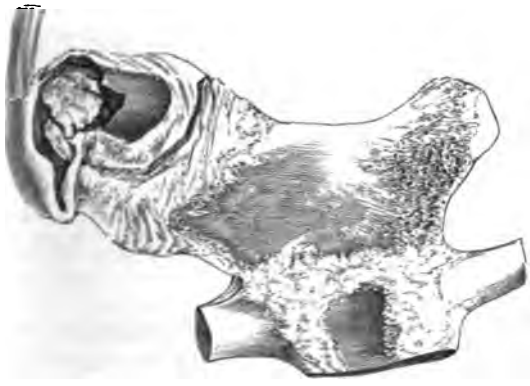


Fig. 76. Fracture of the sternal end of the clavicle, seven days before death. The situation of the joint is shown; the fracture is about an inch from the joint. There is a large bloodclot between the fragments. The outer fragment is pointing directly forwards, i.e. its end pressed against the skin.—Museum of St. George's Hospital, Series I. No. 77.

Fracture of the sternal end of the clavicle is not a common injury. It generally takes place about an inch from the end of the bone, and is accompanied by a well-marked displacement of the outer fragment downwards and forwards in front of the sternum, which has often been confounded with dislocation.[2] The treatment appears to be usually unsuccessful in the same sense as in the common fracture, that is to say, that the displacement remains, but

Fracture of sternal end.

[1] See Gordon 'On Fractures of the Lower End of the Radius and of the Clavicle,' Dublin, 1875, p. 60.

[2] On this head see a paper by Dr. R. W. Smith, 'Dublin Quarterly Journal,' Aug. 1870.

no serious loss of motion results. This fracture, of course, lies external to the attachment of the rhomboid ligament. The occurrence of fracture internal to this ligament has not as yet been proved; its fibres would probably prevent any extensive displacement, though some movement of the inner fragment forwards would still, according to Professor Smith, be possible.

Fracture of acromial end.

Fracture of the acromial end is a much more common injury, and is often accompanied by very great deformity, the effect of the mobility of the scapula, which being now deprived of the natural support of the clavicle, carries the outer fragment inwards, so that it makes almost a right angle with the inner, and in some cases (as in that figured by Professor R. W. Smith, 'On Fractures and Dislocations,' p. 219) the sternal fragment is much elevated, while the shoulder is drawn inwards and forwards, thus adding greatly to the deformity.

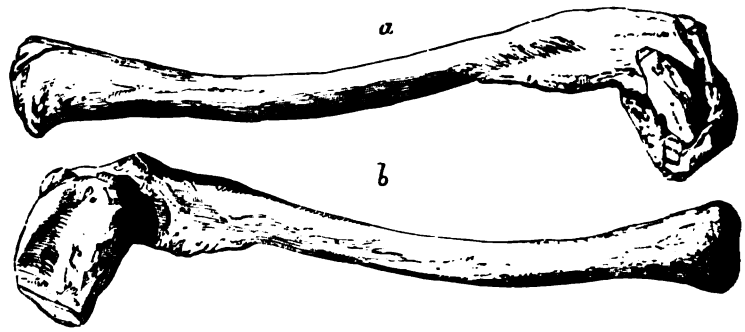


FIG. 77. A recent comminuted fracture of the left clavicle, from a case in which death was produced by other injuries in a few hours. *a*, superior and *b*, inferior view. The external fragment has become placed below the inner one, and is at the same time directed forwards, so that the two fragments form nearly a right angle with each other. Two pieces of the inner fragment have been detached and are lying above it, as seen in *a*. Fig. *b* shows how the outer fragment has passed below the inner. The fracture is situated between the coracoclavicular ligaments and the acromial joint.—From a case by Mr. Canton, in 'Path. Trans.' vol. xii. p. 161.

On the other hand, when the fracture happens to occur just in the interval between the conoid and trapezoid ligaments there may be little or no displacement; at least such is the common impression (as shown in Fig. 73). Dr. Gordon thinks this impression incorrect, and believes that fracture between the conoid and trapezoid ligaments produces the same deformity as any other fracture of the outer end of the bone; in other words, he does not believe that these ligaments have any effect in resisting displacement, and I suspect that his opinion will be found correct.

All these fractures are to be treated on the same principle as the common fracture of the clavicle, i.e. to fix the shoulder in the position best adapted to prevent the displacement characteristic of each; but the difficulty of keeping the scapula fixed is a great obstacle to complete success. This may be combated by fixing a pad on the scapula below its spine and strapping it tightly to the chest: but when the tendency to displacement is considerable, the success of any plan will not be great while the patient is allowed to move about.

Fracture of the scapula.

Fracture of the body of the scapula is usually the result of direct violence; the passage of a carriage over the body or a crush against some obstacle. It is usually easy of detection, for it generally passes through the spine of the bone, and in passing the finger along the spine the broken part can be reached at once, or the shoulder being grasped in one hand and the lower angle of the scapula in the other, the crepitus will be elicited. The fracture, if not com-

plicated with other injuries—which, however, is very often the case—will not in all probability lead to any evil consequences. Should any displacement exist, the parts must be manipulated into position, but this is not generally necessary, since the broad muscles attached to the bone prevent any change in the relative position of the fragments. After reduction, all that can be done is to apply a broad rib-roller, and even if the fracture consolidates irregularly no harm will result. In three or four weeks the patient may be allowed the free use of his arm.

Fracture of the neck of the scapula.

Fracture of the neck of the scapula may, as it appears, involve either the anatomical or the surgical neck of the bone, the former being the constriction around the glenoid cavity external to the root of the coracoid process, the latter the part by which the glenoid fossa and coracoid process are connected to the body of the bone. Fracture, therefore, through the anatomical neck would separate only the glenoid process from the rest of the bone, while fracture through the surgical neck would separate the coracoid process also from the scapula and render it movable. The subject of fracture of the neck of the scapula is one on which much difference of opinion has prevailed, and which is still unsettled. Sir A. Cooper described it as an injury which often simulates dislocation of the humerus into the axilla,[1] and his description is expressly applied to fractures of the surgical neck of the bone, since he points out carefully 'that the coracoid process being attached to the glenoid cavity, and being broken off with it, the crepitus [of the fracture] is communicated through the medium of this process,' and the seat of the supposed fracture is marked in one of his figures. Other surgeons have explained differently the injury which Cooper classed as fracture of the neck of the scapula, some believing that the real lesion was a dislocation in which a portion of the glenoid process was fractured,[2] others that it was a fracture of the head of the humerus.'[3] But neither of these explanations seems to me at all consistent with Sir Astley's very clear description of the symptoms as observed by him; and although there is no dissection in existence from a case of this kind which can show on what precise injury the symptoms have depended, yet as there are certainly specimens in existence of fracture of the surgical neck of the scapula,[4] and as it seems certain that such a fracture might produce the symptoms described by Sir A. Cooper, I see no reason for denying the accuracy of his diagnosis, though the fact that the injury can hardly prove fatal renders the anatomical proof of it hitherto deficient. The reader may consult a very interesting paper by Dr. Lotzbeck of Munich on this subject,[5] in which the symptoms due to both of these varieties of fracture of the neck of the scapula are described, though only from the living subject, and the various opinions which have been expressed on the question are discussed. The symptoms in one of the cases there described 'much resembled dislocation; the arm was lengthened one inch, drawn away from the side, and the acromion prominent; but the injury was easily distinguished from dislocation by the fact that the coracoid process was also displaced, and moved with the arm in passive motion; that such movements were perfectly easy to produce, though very painful; the

[1] Cooper, 'On Dislocations and on Fractures,' 2nd ed. 1823, p. 454.

[2] Malgaigne, 'Traité des Fractures et des Luxations,' vol. ii. p. 551.

[3] Mr. South, 'Chelius' (vol. i. p. 549), says that this has been proved to be so; but if so Sir A. Cooper must have utterly misstated the symptoms of the case which he described.

[4] One in Guy's Hospital Museum is figured in Mr. Bryant's work, vol. ii. p. 377; another in the Museum of the Royal College of Surgeons.

[5] 'Deutsche Klinik,' 1867, abstracted in the New Syd. Soc.'s 'Biennial Retrospect' for 1867–8, p. 240.

length of the arm was at once restored and crepitus obtained; and finally, an irregular fragment of bone was felt in the axilla.' Dr. Lotzbeck also met with another case in which the symptoms were very similar, only that the coracoid process was not movable, and which he therefore believed to be a fracture through the anatomical neck of the bone. In both cases the displacement was reduced and good motion of the joint obtained. The diagnostic signs from dislocation are the ease with which the parts can be put into position, the production of crepitus, and, when this is done, the freedom of passive motion —though this causes much pain—and the sensation of a bony fragment in the axilla. It must nevertheless be admitted that the injury cannot be described with the same confidence as one whose nature has been conclusively proved by dissection.

Fracture of coracoid and acromion processes.

Fracture may also occur either of the coracoid or of the acromion processes alone. That of the coracoid is unquestionably rare as a separate injury, though as a complication of dislocation it is known to occur and is perhaps not extremely uncommon. The fragment is described as being drawn down by the biceps muscle,[1] and it is said that ligamentous union is on that account common. I do not believe, however, that enough is known about the injury to enable us to judge whether this is generally true. The muscles attached to the coracoid process would only displace the fragment in the event of its being entirely torn away from the periosteum, and this I suppose to be rare. And doubtless the statement as to the frequency of ligamentous union in this fracture, as in that of the acromion, rests in a great measure on post-mortem examinations, in which additamentary bones around shoulders affected with chronic osteoarthritis have been mistaken for fragments of old non-united fractures. If fracture of the coracoid process is met with uncomplicated with other injury, and if the fragment is displaced (of which Mr. Bryant records an example under his own care), the arm should be bandaged with the elbow raised and the forearm flexed, so as to relax the biceps muscle, and the parts kept in that position for about a month.

Fracture of the acromion is easily diagnosed by tracing the spine of the scapula with the finger, an abrupt drop marking the seat of fracture. The mobility of the fragment and the dropping of the point of the shoulder will sufficiently prove the nature of the case, and the diagnosis will be confirmed by the crepitus. The surgeon will also notice how the deformity disappears on raising the elbow and recurs as soon as the elbow is allowed to drop. 'In the treatment of this accident,' says Sir A. Cooper, 'the head of the os humeri is the splint which is employed to keep the acromion in its natural situation: and with this view the elbow is raised and the arm fixed.' He also points out the unadvisability of either putting a pad in the axilla or bandaging the elbow too closely to the side, since by both of these plans the head of the humerus is thrown outwards and the fragments separated. The surgeon should raise the elbow and fix it in that position, which places the bones in perfect contact, and endeavour to keep them thus for about three weeks; but it is somewhat difficult to keep the parts quiet, and to this Sir A. Cooper attributes the ligamentous union of fractured acromion, which he believes to be common, and in this belief he has been followed by most authors; but in this case also there is much reason to believe that specimens of old chronic

[1] See a case described by Mr. South, 'Med.-Chir. Trans.' vol. xxii. p. 100. In this case the fragment was pulled down by the short head of the biceps muscle as far as the triangular ligament would allow - about half an inch below and to the outer side of the stump of the coracoid process.

rheumatic arthritis have been looked upon as examples of ununited fracture.[1] At the same time it is very desirable to realise the probability of non-union in this racture, and to endeavour to guard against it.

Fractures of the humerus are divided into those of the upper end, of the shaft, and of the lower end. Those of the upper end of the humerus are: 1. Fracture of the anatomical neck (intracapsular); 2. Of the surgical neck extracapsular); 3. Separation of the epiphysis; and, 4. Fracture of the great tuberosity.

Fractures of the humerus.

1. Pure uncomplicated fracture above the tuberosities—i.e. entirely within the capsule—is a rare injury, and its diagnosis is by no means easy. It is very generally accompanied with impaction, the shaft of the bone being sometimes driven into the upper fragment, whilst in other cases the head of the bone is more or less displaced and driven into the lower fragment (Fig. 79). In a remarkable case recorded and figured by Prof. R. W. Smith the fractured head was entirely reversed, so that the cartilaginous surface had been driven

Fracture of anatomical neck.



Fig. 78. Recent intracapsular fracture of the left humerus, seen from behind. The tuberosities separated from the head and shaft are divided into three fragments and driven outwards. The head, separated from the anatomical neck of the bone, is partly crushed. The shaft is driven upwards, and touches the lower part of the glenoid cavity. The capsule was intact, and has been opened in the dissection to show the fracture.—From Malgaigne's 'Atlas,' pl. v. fig. 1.



Fig. 79. Bony union of impacted intracapsular fracture of the humerus, five years after the occurrence of the accident.—From Prof. R. W. Smith, On Fractures,' p. 192.

to the shaft, while the fractured cancellous tissue was turned upwards towards the glenoid cavity.[2] The diagnosis is in many cases mainly negative. There are not the characteristic symptoms of any of the other fractures to be presently described, nor those of dislocation. If the fracture be firmly impacted no crepitus can be elicited, but some change of shape of the upper end of the bone may be made out, if not masked by the swelling. If, however, the fracture be not impacted, crepitus will be made out; and the surgeon being convinced that the scapula is not injured, and that the injury is seated above the surgical neck, and is not of the tuberosity only, must conclude that it is an

[1] Dr. R. Adams says that in chronic arthritis of the shoulder the acromion is often found to have undergone a solution of continuity from disease, and that this usually but not always occurs at the line of the epiphysis ('On Chronic Rheumatic Arthritis,' 2nd ed. p. 102).

[2] A similar specimen is figured by Hamilton. This author conjectures, with great probability, that these extensive displacements of the upper fragment are effected gradually by the movements of the parts.

intracapsular fracture. Much caution, however, is required not to confound the pseudo-crepitus of effusion into the sheaths of the tendons with the real crepitus of fracture. These fractures unite solidly by bone; in fact there is often a very exuberant production of stalactitic bone, especially when the head is impacted in the lower fragment, and the inflammation which produces this bony effusion must greatly limit the movements of the joint. The only treatment which can be adopted is to remedy any tendency to displacement of the lower fragment inwards which may be present, by means of a pad in the axilla, and to support the arm in a sling. In impacted fracture it is neither feasible nor desirable to disengage the fragments. The patient should be prepared for the loss of motion which will probably ensue, and passive motion should be employed to obviate this as far as possible. Gentle attempts to raise the shoulder should be made as early as the patient can bear them after the first three weeks.

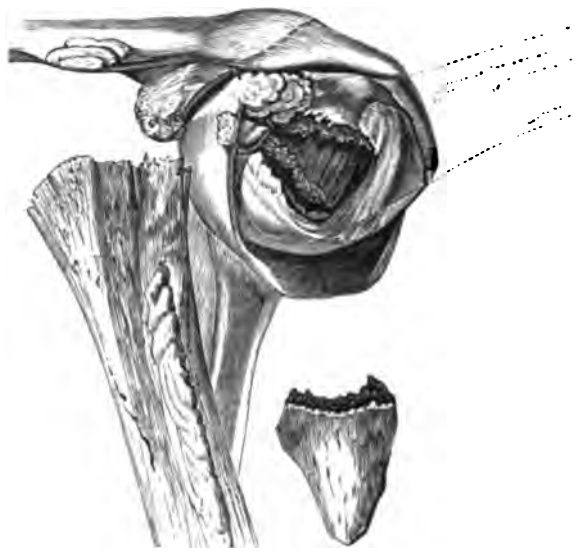


FIG. 80. Fracture of the surgical neck of the humerus, with complete separation of the fragments. The fracture occurred in an old man æt. 77, who died twenty-six days after the fracture, which it had been impossible to reduce. The fracture was situated below the tuberosities and capsular ligament (which latter was nowhere opened), and about an inch above the insertion of the pectoralis major. The detached fragment was separated from the lower fragment and buried in the tissue of the upper. The upper fragment, free from any adhesion, had been drawn up by the supraspinatus, and probably by the other capsular muscles, into such a rotation upwards and outwards that the great tuberosity is buried under the acromion. In other words, the position of the upper fragment corresponds to that of the arm in its greatest elevation, and that of the lower fragment to that of the arm in its greatest depression. The dotted line shows the position that the lower fragment must have taken in order to bring the humerus into a line.—Malgaigne, pl. vi. fig. 3.

Extra-capsular fracture, or fracture of the surgical neck.

2. The ordinary fracture of the neck of the humerus is the extra-capsular or the fracture through the surgical neck, i.e. below the tuberosities. The arm is shortened; the lower fragment can be felt projecting into the axilla, where its sharp, irregular outline can easily be distinguished from the globular head of the humerus; the shoulder has not the pointed outline of dislocation; the arm is much more easily movable, and when its length is restored crepitus will be felt. The upper fragment is usually tilted outwards by the muscles inserted into the great tuberosity (Fig. 80); the displacement of the lower fragment inwards and upwards is due partly to the action of the force, partly to that of the flaps of the axilla and the muscles which pass from the scapula to the humerus below the fracture, and partly to the direction of the line of fracture. In some cases the lower fragment lies 'anteriorly externally, and even posteriorly,' as shown by Malgaigne, and it may be impacted in the tissue of the upper fragment.

This fracture is usually treated by the application of a case or splint of leather or guttapercha moulded to the outside of the shoulder, and opposed by a large pad in the axilla, or a crutch similar to that used for fractures of the clavicle, or a splint about two feet long made of leather, bent in the middle to

an acute angle, which is fitted into the axilla, while one limb of the splint rests upon the chest and the other supports the inside of the arm. The treatment of this fracture by a case of four straight splints, as for fracture of the shaft, is very ineffective, since all the splints will probably be found on careful examination to be placed on the lower fragment only. The same precautions should be adopted for avoiding stiffness of the joint as recommended in the former case; but some loss of the power of elevating the shoulder is a very common result; and is usually attributed to inflammatory thickening of the lower portion of the capsule.

I have described these fractures separately from each other as purely intra- or extra-capsular, but in practice there can be no doubt that they are often mixed, and what is called 'a fracture of the anatomical neck of the humerus' is really an injury in which the greater part of the line of fracture is external to the capsule; but a piece has been comminuted, or a subordinate line of fracture has run upwards into the joint. This is so in a preparation put up by Sir B. Brodie in St. George's Hospital Museum as 'fracture of the anatomical neck,' and the same was the case in a patient under my care, who presented the unusual complication of partial rupture and obstruction of the axillary artery, leading to gangrene of the arm and necessitating amputation at the shoulder-joint.

3. Separation of the upper epiphysis is a well-marked accident, very clearly described by R. W. Smith, whose description I had an opportunity of verifying in the case which furnishes the accompanying figure (Fig. 81). The patient is a young person below the age of 20, and usually much younger; the arm is neither lengthened nor shortened; the lower fragment projects somewhat inwards, causing 'a striking and abrupt projection situated beneath the coracoid process,' which Prof. Smith calls 'the most remarkable feature of this injury;' and this projection has not the sharp outline of an ordinary fracture, but 'feels rounded, and its superior surface is smooth and slightly convex.' When the injury is recent the lower fragment can be brought into its natural position, and then the prominence will be obliterated, and crepitus can be felt, though this may not be exactly the crepitus of fracture. The lesion may be treated by any of the plans which are used in other injuries about the same part, but the projection will probably remain permanently. There is, however, far less probability of loss of motion than in the fractures of adult life. The line of fracture, 'must be remembered, is below the tuberosities, and the fracture is therefore mainly, if not entirely, extracapsular.[1] It seems to unite usually with but little inflammation.

Separation of the upper epiphysis.



81. Separation of the upper epiphysis of the humerus. Taken from a boy set. 15, under my care, in whom the diagnosis rested only on the symptoms during life. He recovered, with, I believe, complete use of the joint.—Holmes's 'Dis. of Childhood,' 2nd ed. p. 249.

4. Fracture of the great tuberosity is known by the increased width of the upper end of the bone, and the presence of a bony prominence below the acromion, which may possibly be made out as distinct from the head of the

Fracture of the great tuberosity.

[1] R. W. Smith, 'On Fractures,' p. 203.

bone. The acromion is somewhat prominent, though less so than in dislocation, and the arm may be separated from the side, but can easily be brought back to it; and a thorough examination of the hand in the axilla will convince the surgeon that the head of the bone is in the glenoid cavity. There are cases, however, in which this fracture has occurred as a complication of dislocation (see fig. 92). If the separation be extensive and complete, the union may be ligamentous; in many cases bony union seems exuberant, and then considerable loss of motion will follow. Beyond keeping the parts at rest, and pressing the fragment and the head of the bone together by means of a pad in the axilla, opposed by a cap over the shoulder, I do not see what is to be done in the way of treatment.

Oblique fracture of the head and shaft of the humerus.

In a paper by Dr. Ogston ('Lancet' 1876, vol. i. pp. 420, 491), the reader will find an interesting series of cases believed to be instances of oblique fracture running downwards through the upper end of the humerus. Dr. Ogston believes (and certainly his cases render the conclusion difficult to resist) that besides the above-described fracture of the great tuberosity, 'there exist also cases where the articular portion of the humerus is detached in conjunction with the greater tuberosity (as asserted by Guthrie) by a fracture running obliquely downwards and backwards, the line of fracture occupying at its upper part the situation of the bicipital groove. The lower fragment is formed by the shaft in conjunction with the lesser tuberosity. Such an injury is usually produced by a fall on the shoulder, and it exhibits characteristic symptoms. These are increased antero-posterior diameter of the shoulder; prominence of the lesser tuberosity at the anterior part of the shoulder, the prominence obeying all motions of the shaft; the existence of the head in the glenoid cavity, not moving with the shaft, save only to a limited degree, with very extensive movements of the arm; crepitus sometimes absent, best elicited by rotating the shaft or pushing it up and down in the direction of its long axis; powerlessness of the arm to the patient, but pretty free mobility to the surgeon; and a position of the arm not unlike that of a dislocation, but the elbow capable of being readily pushed into contact with the side. The shortening of the arm may be present or absent; it is present when the smaller tuberosity has pierced the fibres of the deltoid. The deformity cannot be entirely reduced, but the injury leaves a useful arm in spite of the deformed shoulder.'

'It is rather astonishing to find, in both series of cases, the marked impossibility of removing the deformity by any means whatever. In the present state of our knowledge on the subject it seems probable that this is owing to the *tendon of the biceps slipping into the cleft between the fragments.*'

Fracture of the shaft of the humerus.

Fracture of the shaft of the humerus occurs usually somewhat below the middle, though any part of the bone may give way. It is caused by any kind of violence, and sometimes by muscular action.[1]

The displacement varies with the direction of the line of fracture and

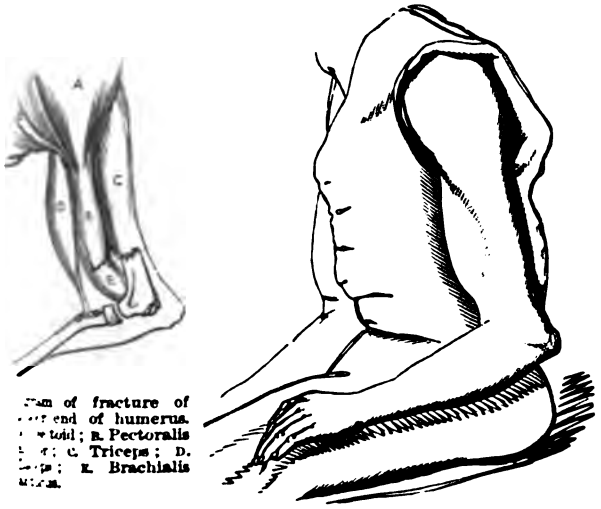
[1] In fractures from muscular action, however, there is reason for suspecting in many cases that the bone may be diseased. Thus, a schoolmaster in striking a boy with his cane fractured the humerus. Some weeks afterwards (the fracture having in the meantime united) a tumour showed itself at the seat of injury, for which he became a patient at St. George's Hospital, where amputation at the shoulder-joint was performed. In other cases there is no evidence of disease; as in that of an Army surgeon, which a correspondent was so kind as to communicate to me, who broke his arm in throwing a cricket ball. The fracture united kindly, and he continued quite well. I once saw a case in which a strong healthy young man was said to have broken his thigh in walking across the room. The fracture certainly existed, and united in the usual period.

other circumstances. Frequently it is not very much marked. There is seldom any difficulty in correcting it, or in procuring union without deformity. A case of four straight splints or a leather or guttapercha splint, must be applied for about six weeks, when the fracture will be soundly united. The hand is to be carried in a sling, which should not be long enough to press the elbow upwards.

Of the lower end.

Fractures of the lower end of the humerus may be divided into: Simple transverse fracture above or below the condyles; fractures running between the condyles into the joint; fracture of either condyle; and, separation of the epiphysis.

The transverse fracture of the lower end of the humerus is of interest, inasmuch as it somewhat resembles dislocation. Both injuries are common in youth.[1] In the fracture the lower fragment along with the forearm is usually carried backwards, producing a projection behind the joint, and a prominence of the triceps tendon, as in dislocation; and there is a projection in front near the bend of the elbow, as in dislocation. Here, however, the resemblance



...am of fracture of ... end of humerus. ... toid; B. Pectoralis ... ; C. Triceps; D. ...ps; E. Brachialis ...

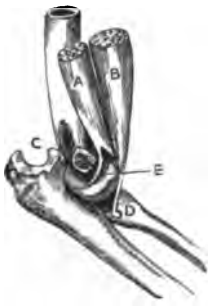


Diagram of dislocation backwards. A. The brachialis anticus torn by the displaced end of the humerus; B. The biceps; C. The greater sigmoid cavity of the ulna; D. The bicipital tuberosity of the radius; E. The end of the humerus.

... Diagrammatical representation of fracture of the lower end of the humerus, contrasted with dis...ation of both bones of the forearm backward. The figure (from Liston) shows the general features ... dislocation.

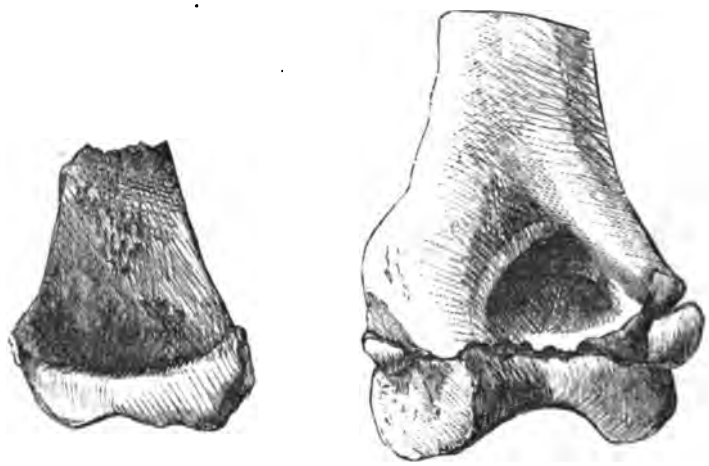
...es. In the fracture the parts can commonly be reduced and crepitus ...ained. The projection in front is seen to be above the bend of the elbow, ... to have a sharp outline, whilst in dislocation the prominence is below the ...nd of the elbow, and is rounded. But the most unfailing distinction is, that ... measurement between the olecranon and internal or external condyle is ...ural in the fracture, while in the dislocation it is much increased. How... great the swelling may be, one or other of the condyles can almost cer...ly be made out. In some cases, especially when the fracture is caused ... direct blow, the displacement of the lower fragment may be forwards,[2] in ...ch case there can be no difficulty in diagnosis.

The separation of the lower epiphysis of the humerus is difficult to

[1] In an interesting, and, I believe, unique case recorded in the New York 'Archives of ... Surg.' vol. i. p. 333, the ulna (alone) was dislocated backwards while the humerus was ... fractured just above the condyles.

[2] See a preparation in the Museum of St. George's Hospital, Ser. i. No. 97.

distinguish from this injury, though it occurs lower down. In this fracture either the whole epiphysis—or, as Dr. R. W. Smith thinks, only the part which forms the trochlea and capitellum—is separated from the shaft of the bone and carried backwards with the forearm.[1] Prof. Smith states that the lower epiphysis of the humerus is placed entirely below the condyles, and therefore describes the separation of the epiphysis as being necessarily 'infracondyloid.' This is certainly incorrect, as I have shown elsewhere, and as the annexed figures prove. The condyles are epiphyses as well as the trochlea and capitellum, and form pieces, though detached pieces, of the same epiphysis, as is correctly described in the ordinary anatomical works. At the same time it is quite possible that in separations of the lower epiphysis only the part which belongs to the trochlea and capitellum may be broken off, leaving the condyles attached to the shaft of the bone, but I am not aware of the existence of any preparation showing this form of fracture. We may conclude, then, that fracture may occur at any age, through the lower part of the



A B

FIG. 83. Two figures to show the position of the epiphysial line in the lower end of the humerus, A, in early infancy, B, at the age of fifteen, showing that in early life all the part which afterwards forms the condyles is cartilaginous, and that subsequently the condyles, though they are formed distinct from the articular end, are also epiphyses. A fracture might, therefore, either separate them from the shaft, along with the epiphysis, or, on the other hand, separate the bulk of the epiphysis, and leave the condyles attached to the shaft.—From Holmes' 'Surgical Dis. of Childhood,' pp. 251, 252.

shaft more or less close above the condyles; and at early periods the whole epiphysis may be separated, including the condyles, or only its infracondyloid part. Thus there would be three forms of transverse fracture of the lower end of the humerus: 1. Supracondyloid; 2. Disjunction of the entire epiphysis; 3. Partial disjunction, or infracondyloid.

Stated shortly, the signs of these three fractures, as they are commonly seen, would be as follows: (*a*) In front of the joint. In the common fracture of the lower end of the humerus (displaced backwards) the lower end of the upper fragment projects in front and above the bend of the elbow; so it does in the other two fractures, but in the infracondyloid fracture the projecting part is wider, equal in breadth to that of the opposite humerus from one condyle to the other; and if the swelling is not too great the condyles can be made out as forming a part of it, while in the disjunction of the entire epiphysis the condyles will remain attached to the lower fragment, and the

[1] 'Brit. Med. Jour.' Aug. 17, 1867.

upper fragment will therefore be higher and less broad. (*b*) Turning to the back of the joint, two prominences are seen, one external, the other internal, in all three forms of fracture, as well as in dislocation. In all these injuries the two prominences are on different vertical levels, the internal (which in all of them is formed by the displaced olecranon) being the higher. The external prominence in dislocation is formed by the head of the radius, and is therefore far more remote from the internal than it is in any of the fractures [1] in which it is formed by the part of the humerus carried backwards with the radius, viz. the capitellum only in the infracondyloid fracture, the capitellum and external condyle in the disjunction of the entire epiphysis, and probably some part of the external condyloid ridge of the humerus, in addition to the condyle in the common supracondyloid fracture. In all four forms of injury the forearm is generally flexed, and the hand midway between pronation and supination.

T-shaped fractures and fractures of either condyle.

The other fractures which communicate with the elbow are often comminuted. Some are of a T-shape, consisting of a transverse branch above the condyles and a vertical one between them, the condyles being movable on each other with crepitus, and the end of the bone increased in width. Others are mere linear fractures running from the outer or inner side of the bone into the joint, so as to separate the external or internal condyle. It seems that the prominent extremity of the latter portion of the bone may be separated from the shaft without implicating the joint.

The treatment of all these injuries is the same. The elbow must be bent to something above a right angle, so that if ankylosis should unfortunately occur the hand may be in good position. This position may be maintained by an angular splint in the bend of the elbow; or if there is any strong tendency to displacement of the lower fragment backwards the angular splint may be applied behind, while a straight splint is put in front of the arm to push back the upper fragment. After the end of three weeks passive motion must be sedulously made, the splints being removed and reapplied daily. Dr. Hamilton even recommends the total disuse of splints after the first seven days in fractures of the elbow, and the persevering use of passive motion daily, remarking, that 'though at this time no bony union has taken place, yet the effusions have somewhat steadied the fragments, and the danger of displacement is lessened, while the prevention of ankylosis demands very early and continued motion.' This, however, does not of course apply to fractures which are entirely above the condyles, but only to those in which the elbow-joint is clearly implicated.

We must now speak of fractures of the forearm.

Fracture of the olecranon.

The olecranon process is usually fractured by a fall on the elbow, and sometimes by muscular action. The fragment is generally drawn upwards by the triceps muscle, though if the periosteum and the fibrous expansion around the bone is not broken there may be no separation. Bending the forearm will make the interval more distinct, if there is any difficulty in detecting it, which, however, is rarely the case. The loss of the power of extending the forearm is sometimes complete—more commonly the patient can perform this action, though with pain and difficulty. Effusion into the elbow-joint generally occurs quickly, for the fracture almost always implicates the joint. It is said, how-

[1] Professor Smith says that in dislocation the vertical distance between the two tumours averages one and a half inch, while in infracondyloid fracture it seldom exceeds three-quarters of an inch.

ever, that in rare cases only the tip of the process is broken off and the synovial membrane left intact.

This fracture often unites by ligament only—but also by bone—and then frequently with obvious evidence of inflammation (Fig. 84). The joint is often left with hardly a trace of injury to its functions. This will necessarily depend in a great measure on the closeness of apposition of the fragments, but also on the avoidance of subsequent inflammation, and it is to these two indications that the treatment should be addressed. The first thing is to relax the triceps muscle completely by putting the arm in complete extension on a long splint reaching from near the shoulder to the palm, leaving the fracture uncovered. One of the plans used in fracture of the patella may be employed here also to draw the movable fragment downwards. Inflammation must be combated by cold, evaporating lotions, and leeches. If, however, acute inflammation nevertheless sets in and persists, the surgeon must not allow ankylosis to occur in the extended position, but should examine the joint under chloroform, and if he finds that adhesions are forming he should place it at an appropriate angle and allow it to ankylose in the bent position. In ordinary cases the splint should be removed after a month, and passive motion be made daily, with great care at first, so as not to rupture the newly-formed union.[1]



FIG. 84. Fracture of the olecranon, united by bone. The edges of the fracture *a*, *a* are united by bone at the inner side, but at the outer they are separated by a considerable interval. A large mass of newly-formed bone, *b*, extends over the back of the olecranon, and forms a sort of splint behind the fracture. It is perforated by numerous large holes, and separated in many places by a distinct interval from the back of the olecranon process. —From a specimen (Ser. I. No. 102) in the Museum of St. George's Hospital, of which there is no history.

As in fracture of the patella so in that of the olecranon when the union has failed and the limb is thereby rendered useless, it is quite justifiable to cut down (with antiseptic precautions) and unite the fragments by suture. An interesting example of the success of this operation is recorded by Sir W. MacCormac in the Clinical Society's Trans. vol. xiv. p. 210.

Compound fracture of the olecranon.

When the fracture is compound it is perhaps better, if the wound is small and uncomplicated, to treat it at first with a view to immediate union of the wound, so as to convert it into a simple fracture and preserve the motion of the joint; but if there is considerable laceration and the joint is very freely opened, the choice lies between excision and ankylosis in the flexed position. The former would be indicated if there is reason to suspect the presence of splinters or foreign bodies in the joint, or if the soft parts are much torn; but in most cases it is, I think, better to be content with ankylosis. Should much suppuration follow and the bones become extensively exposed, secondary excision can at any time be practised, for excision of the elbow, unlike excision of the knee, may be performed with success in the acute stages of inflammation.

Fracture of the coronoid process.

Fracture of the coronoid process occurs as a complication of dislocation of the elbow, and is treated of under that head (see Fig. 96, p. 265). It is also spoken of as a separate injury, but I am not aware that its existence as

[1] In this fracture also Hamilton is in favour of making passive motion daily from about the seventh day.

such has ever been proved by dissection. It is said to unite usually by ligament, in consequence of the displacement of the fragment by the brachialis anticus. The treatment would, therefore, consist in keeping the forearm fixed in the bent position for about three weeks, should this injury be diagnosed.

Fracture of head of radius.

Fracture of the head and upper part of the radius occurs as a complication of dislocation (q. v.), and has sometimes been found as a complication of other injuries to the joint, such as compound fracture or gunshot wound. The cases which have been recorded and figured have been either longitudinal fissures extending downwards from the articular surface, or comminuted fractures in which the bone has been more or less shattered.[1] As a substantive injury little is known about it, and its existence is generally unrecognised till after dissection or excision. I incline, however, to agree with Dr. Hodges in believing that it is probably more common than is usually supposed.

Of both bones of the forearm.

The most common fracture of the central part of the forearm is that in which both bones are broken, which usually occurs about the middle, though, as the fracture is generally caused by direct violence, any part may be broken; and I have seen cases where from the passage of a wheel over the limb the bones have been splintered into a great number of fragments. In children the fracture is often incomplete, being marked by a mere bending of the bones, with no crepitus, the upper part sharing in any movement impressed on the lower (see Greenstick Fracture, p. 118). The displacement in fracture of both bones of the forearm is often very considerable when the fracture is very oblique or much comminuted, but there is not in general any serious difficulty in getting the bones back into position. Nor is the treatment generally unsatisfactory even in somewhat complicated cases. There are, however, a certain number in which the power of rotation of the hand is more or less lost, a result which is ascribed by Mr. Flower[2] (following Lonsdale in this particular) to the fact that the two portions of the radius have been put up in different positions as regards supination. There are also more numerous instances in which some amount of deformity is left after union, but without any loss of motion. The indications are to keep the fragments from falling together, i.e. to obviate any tendency of the fragment of the radius to point towards the ulna, or *vice versâ* and to see that the natural line of the superficial portions of both bones is completely restored. For the former purpose it is desirable in complicated cases to place a graduated compress in the interosseous space. With regard to the latter, the defect alluded to by Lonsdale and Flower of putting up the two parts of the radius in different positions of supination is most surely avoided by the completely supine position of the whole forearm. This, however, is more irksome to the patient than the half-supine position. The latter is generally adopted, and answers well for all ordinary cases. The splints in general use are two straight well-padded wooden ones, at least as broad as the limb, and extending from the elbow to the wrist, on the back and front; or a pasteboard, leather, or starched case may be applied at once. The bones should be kept in apposition for a month, care being taken to give passive motion to the fingers if they seem inclined to stiffen.

Bending of bones in childhood.

Fracture of ulna or radius only.

The ulna or radius alone may be broken in its centre. The ulna can only be thus fractured by direct violence, and this is also the cause of fracture of the shaft of the radius in almost all cases, since the result of a fall on the hand if the radius gives way is almost always Colles's fracture. Here also the great point is to see that the fragments do not fall towards the other bone, and for

[1] See a paper by Dr. Hodges, 'Boston Medical and Surgical Journal,' Jan. 18, 1877.

[2] 'Syst. of Surg.' 3rd ed. vol. i. p. 963.

this purpose to thrust them out if necessary by a pad in the interosseous space. The sound bone, acting as a splint, will in all probability prevent any displacement, and no lasting effects need be apprehended.

Colles's fracture of lower end of radius.

Colles's fracture,[1] or fracture of the radius close to its lower end, is a very frequent consequence of falls on the palm of the hand, especially in old persons. It is one of the few fractures which are believed to be more common among women than men, and it is very liable to be followed by a considerable amount of stiffness of the wrist and fingers, due in part, very likely, to a tendency to rheumatism in the patient. The radius is broken generally about an inch or a little more above its lower end, but sometimes much nearer the wrist, as in Fig. 86. The displacement which usually accompanies this injury, and which is so characteristic of it that it enables a surgeon to recognise it at a glance, is well shown in Fig. 85, taken from Prof. Smith's work. The lower end of the radius carrying the hand is driven backwards and outwards, causing a deviation of the hand from the axis of the limb, a prominence of the styloid process of the ulna, a projection on the back of the forearm just above the wrist, and a corresponding projection on the front at a somewhat higher level caused by the flexor tendons being put on the stretch in passing over the upper fragment, which is usually displaced considerably forwards and inwards (see Fig. 86). The power of pronation and supination is lost. If the hand can be restored to its natural position crepitus will be felt on rotation. The line of fracture is usually



FIG. 85. Colles's Fracture, showing the most common deformity.—From Professor R. W. Smith, 'On Fractures,' p. 137.

nearly transverse, rarely so oblique as to allow of very great displacement, which, indeed, is impossible so long as the ulna and the internal lateral ligament of the wrist-joint remain entire. Much difference of opinion prevails as to whether this fracture is frequently impacted or no. It is believed to be so by most English and French authors,[2] and the appearance of fractures which have been long united with some amount of displacement certainly bears a close resemblance to the appearance of old impacted fracture. But the Irish surgeons, and notably Prof. R. W. Smith and Dr. Gordon, deny that impaction is common; and they attribute the appearance referred to not to penetration of the lower fragment by the upper at the moment of the accident, but to subsequent inflammation which has produced an irregular callus encircling both fragments. There is no doubt, however, that in many cases there is an

[1] Mr. Colles's description of this fracture will be found in the 'Ed. Med. and Surg. Jour.' April 1814; or in the recent edition of his works by the New. Syd. Soc.

[2] The testimony of eminent pathologists leaves no doubt, to say the least, of the *occasional* occurrence of impaction of the upper fragment into the lower. See Callender, 'St. Bartholomew's Hospital Reports,' vol. i. p. 283, where three cases are related, in which, the patient dying on the spot from other injuries, this impaction was found. Another typical instance of impaction is related in the 'Annals of Anatomy and Surgery,' Brooklyn, March 1881, p. 117, where the upper fragment was so firmly impacted in the lower as to have crushed its spongy tissue to such an extent that the two fragments no longer fitted each other on reduction, and some permanent flattening of the anterior curve of the bone must necessarily have remained.

almost insuperable difficulty in disengaging the fragments, which can hardly be accounted for except on the theory of impaction, and for myself I certainly hold the general view.

The cause of the difficulty often experienced in reducing this fracture has been variously explained—and it is a matter of more than theoretical interest, since the method of reduction adopted will to some extent vary with the views the surgeon entertains as to the obstacles to reduction. That impaction is a frequent obstacle I myself have no doubt. This must be combated by judicious extension and pressure applied to the fragments under anæsthesia. The action of muscles has been invoked in this as in all other fractures, and many eminent surgeons believe that the supinator longus or the pronator quadratus oppose reduction. This seems to me improbable, but in any case would be easily remedied under anæsthesia. Some authors believe that the tension of the untorn periosteum on the dorsal face of the fragment often opposes reduction. This membrane will be relaxed by extension applied with the hand in the hyper-extended position, a manœuvre which should always be adopted when other means fail. Lastly, it has been taught that the main obstacle is the implication of the displaced head of the ulna in the annular ligament and tendon of the Flexor ulnaris, and that this displacement must be remedied before the fragment can be returned to its actual position.



Fig. 84. A recent specimen of Colles's fracture, from the body of a boy who died of other injuries. *a* shows the fracture. The upper fragment is displaced considerably inwards and forwards. The lower fragment (between *a* and *b*), which is very small, remains in place, but can be displaced forwards by placing the hand in the position commonly assumed in this injury; *b* shows the wrist-joint; *c* the extensor ossis metacarpi pollicis; *d* the flexor carpi ulnaris tendon cut short.

I would refer the reader to an interesting paper by Dr. Packard in the 'Am. Jour. Med. Sc.' Jan. 1879, to one by Dr. MacLeod in the 'Brit. Med. Journ.' July 12, 1879, and to another by Prof. Bennett in 'Brit. Med. Journ.' May 22, 1880.

In an elementary work of this kind it would be out of place to enter into any prolonged theoretical discussion as to the exact mechanism of this injury. I will content myself with quoting the following summary by Dr. Pilcher, of Brooklyn, of a paper on this subject in the 'Annals of Anatomy and Surgery,' March 1881.

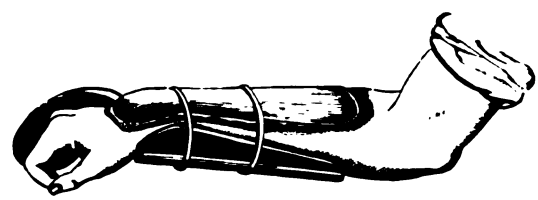
'Fractures of the lower end of the radius may be produced: 1. Simply by the direct transmission of force through the carpus, longitudinal fissuring being the result; 2. Simply by avulsion through the forcible distension of the anterior ligaments, transverse fractures resulting. When comminution of the lower fragment is present, it may be the result of the wedge-like action of the carpus driven up against the articular face of the radius by direct force, fissuring it, followed by the avulsion of the lower part of the radius through distension of the anterior ligaments, this being the most frequent mode of its production; or by the splitting of the lower fragment through the descent into it from above of the upper fragment, a comparatively rare occurrence.'

The treatment is very often not entirely successful either in restoring the shape of the parts or the movements of the wrist and fingers, though the latter may be trusted to improve gradually. It is well to warn the patient of this. Several plans are in common use. Some surgeons use two straight splints, anterior and posterior, not reaching much beyond the wrist, and when these splints are used the surgeon generally draws the hand towards the ulnar side by means of the bandage which fixes the splint, or by a webbing strap. The pistol-shaped splint is a very common apparatus, applied either to the front, or, as is perhaps better, to the back of the forearm and hand, with a short splint on the palmar aspect of the forearm.

Dr. Gordon [1] teaches that in this fracture both the fractured ends are displaced forwards, and this I believe to be true, since the backward displacement of the hand must tilt the upper end of the lower fragment forwards. Thus the natural concavity of the front surface of the radius is lost. It is to the restoration of this concavity, i.e. to the correction of the forward displacement of the two fractured surfaces, that the surgeon's efforts are to be directed. Dr. Gordon also follows Prof. R. W. Smith in denying the existence of impaction as a common condition. The means by which he proposes to remedy the displacement, or to restore the natural concavity of the radius anteriorly, consist in first reducing the fracture by traction on the hand and pressure on the fragments, placing the hand in the prone position, then applying to the anterior surface of the forearm a splint (Fig 87 A) to which a wooden conical or triangular piece (Fig. 87 C) is so attached that the external border of the splint projects beyond it; and on the back of the fore-arm a straight splint (Fig. 87 B) more thickly padded over the wrist than over the forearm. The splints are to be fixed by two webbing straps, not by bandage. The triangular bevelled end of the anterior radial splint lifts up the lower end of the upper fragment of the radius, the pressure made by the straps (which is thrown entirely on the ulnar side of the limb in consequence of the projecting border of the radial splint) remedies the projection of the ulna inwards, and the depression of the hand elevates the lower or carpal fragment and raises it to the level of the upper fragment. Those who have tried this plan adequately report in high terms of its results,[2] and a somewhat similar plan is said [3] to have been employed by Sir P. Crampton.



FIG. 87. Gordon's Splint, for fracture of the lower end of the radius.



The splints applied.

I have used all three plans; Dr. Gordon's, indeed, only in one or two instances, but in one of these with great success. My own impression is that

[1] 'On the Treatment of Fractures of the lower Extremity of the Radius,' Belfast, 1862.
[2] See Porter, 'Dublin Quar. Jour.' May 1865. [3] Ibid. Feb. 1862.

all methods give a good result in non-impacted fractures which can be and are accurately set at the time of the injury, and where the patient is healthy and tractable; and even when some deformity remains the movements of the wrist and fingers are preserved if timely passive and active movement are insisted on. Dr. Gordon seems to me to have somewhat exaggerated the frequency of the ill-success which, however, does undoubtedly sometimes attend the common methods of treatment.

Another splint which seems now coming into use in this fracture is Carr's, which is intended to fulfil somewhat the same indications as Gordon's. It consists of two pieces, palmar and dorsal. The palmar splint is padded so as to form a convexity which may fill up and support the concavity of the radius. An oblique round cross-piece or bar ends the splint, which is to be fitted exactly under the metacarpo-phalangeal articulations, sloping therefore from without inwards and backwards. The patient's arm is secured to this splint by one or two turns of bandage and his fingers are made to grasp the bar. In doing this, most fractures are reduced; or, if it is preferred, the surgeon may reduce the fracture before applying the splint. A thin dorsal splint is then applied. The advantages claimed for this splint are, that it enables the patient to move his fingers and thumb and thus avoids stiffness, and that it secures a better position for the fracture. In the 'Brit. Med. Journ.' April 9, 1881, p. 560, will be found an account of some cases under Mr. Heath's care treated with success with these splints, and its use at St. George's Hospital has also been satisfactory.

Whatever treatment is adopted, the part should not be kept too long stiff; the position of the parts should be verified at frequent intervals, and after about three weeks the limb should be taken out of the splints, and careful passive motion given to each finger-joint and to the wrist, the limb being first well steamed.

The lower end of the radius is also in rare cases comminuted or fractured in such a direction that its lower fragment is displaced forward, and sometimes the lower ends of both bones are crushed. Such accidents should be treated on simple straight splints, after careful reduction. When comminuted fracture affects both bones they are very liable to be soldered together in the process of union, causing entire loss of the rotatory movements of the hand, and the surgeon must combat this tendency as well as he can by timely passive motion.

Fractures of the carpus.

Fractures of the carpal bones are rare, at least they are rarely diagnosed—being possibly in many cases masked by the injury to the soft parts, which is usually severe. The accident in itself is not a very formidable one, for two or more of the carpal bones may be ankylosed together without any loss of the functions of the hand. I have seen a case in which, after a severe crush of the wrist accompanied by fracture, the greater part of the semilunar bone became loose and was removed, but the patient recovered with a very useful hand. Rest on a splint and cold lotion till the movements of the hand are no longer painful, followed by careful passive motion if necessary, comprise all that is required in the way of treatment.

Fractures of the metacarpus and phalanges.

Fractures of the metacarpal bones and phalanges are generally the result of direct violence, though any of these bones (at least any above the terminal phalanges) may be fractured by a blow or a pull upon the finger. When a metacarpal bone is broken the nature of the injury is at once declared by the dropping of the knuckle, and the break in the line of the dorsal surface of the bone. The treatment consists in bandaging the fist round a padded stick or a

ball, or in putting the hand on a palmar splint which carries a pad of cork or other material, supporting the dropped knuckle at a proper level.

Fracture of a phalanx requires only a splint reaching into the palm of the hand, and keeping the finger perfectly quiet and straight.

Treatment may be given up in about three weeks in both cases.

Compound fractures in the upper extremity.

Compound fractures in all parts of the upper extremity are very common, and are of far less gravity than the corresponding injuries in the lower limb. Gangrene also, if it occurs after the injury, is of less consequence to life, and secondary amputation much more likely to succeed. Much, therefore, is justifiable in the way of removing fragments, endeavouring to promote the union of wounds, and so saving the limb, which would not be allowable in compound fractures of the thigh, leg, and foot. Indeed, in the hand it is often better to allow the parts to slough away and afterwards trim up the stump if necessary, rather than by primary amputation to sacrifice fingers, or parts of fingers, which may ultimately recover and prove very useful. Primary resections, also, which are so disastrous in the hip and knee, may be practised with good hope of success in the shoulder and elbow, and are perhaps preferable to the mere removal of splinters—operations which will most likely be followed by ankylosis, and involve probably the same risk to life as the more formal excision. This, however, does not apply, I think, to the wrist and carpus, where the removal of fragments is less likely to impair the movements of the fingers, than excision of the whole articulating surfaces.

In injuries of the hand, the thumb, or any part of the thumb, should be preserved in any condition, stiff or otherwise. Any portion of the metacarpus is useful if in connection with a thumb or movable fingers, since a very efficient apparatus can be fitted on to it. But if the flexor or extensor tendons of a finger are torn to pieces, or its joints destroyed, so that it must be stiff afterwards, it would only be in the way ultimately, and should be at once amputated.

Dislocation of the clavicle.

The clavicle may be dislocated at either its sternal or acromial end, if we use the old nomenclature. It has now become more common to speak of the latter accident as a dislocation of the acromial extremity of the scapula.

The sternal end of the clavicle may be dislocated forwards, backwards, or upwards. Dislocation downwards is impossible, on account of the first rib.

Dislocation forwards is the most common, though even this is a rare injury, for the sternoclavicular, like some of the other joints, which in the skeleton appear very weak (for instance, the knee), is provided with so many and such powerful ligaments, and is so protected by the mechanism of the parts, that it is little subject to displacement. The force which would otherwise act on this joint is usually neutralised and resolved in the numerous and very powerful articulations through which it is transmitted, and when this is not the case it is generally expended in breaking the clavicle. When dislocation forward occurs, the head of the bone rests on the front surface of the sternum. The only ambiguity which can exist is between this injury and a fracture of the clavicle close to its head; but the shape of the displaced head is generally quite characteristic; or in case of doubt measurement before reduction and examination afterwards will show in the case of fracture that the injured bone has not the length of the sound clavicle and that crepitus is present. Reduction is usually easy, by drawing the shoulders backwards, but it is difficult to keep the parts in position. The arm must be put up, as in fractured clavicle,

with the elbow carried further forward than in the common fracture, or the hand may be bandaged on to the opposite shoulder. Nélaton prescribes that a truss shall be applied to press upon the displaced head. In the only case I have seen the displacement was not corrected, but the arm remained quite useful, and this is the ordinary event.

In the dislocation backwards the head of the bone is thrown between the sternum and the trachea, and sometimes produces the most alarming dyspnœa, or even death. It is usually caused by direct force. The dyspnœa, the consequent bending forward of the head (in order to make room for the displaced bone), and the changed shape of the parts leave no doubt as to the nature of the injury. Reduction is generally easy by drawing the shoulders backwards, and this position should be maintained by 'a splint passed behind the shoulders, with a pad between it and the spine, the shoulders being drawn to the splint by a bandage.'[1] After about a fortnight the splint may be withdrawn, and the patient kept quiet in bed till all tenderness and pain have subsided.

Dislocation upwards (suprasternal) is a rare injury, of which only about eight cases are on record. Its anatomy is now fully known, from a case which was carefully dissected and published by Professor R. W. Smith,[2] the man having died of other injuries. Dr. Smith's account contains two excellent drawings of the appearance of the part during life and of the dissected specimen. The head of the bone, carrying the interarticular cartilage with it, had been thrust between the two heads of the sternomastoid muscle, and lay in contact with the opposite clavicle. The sternohyoid muscle was behind it; the sternal tendon of the sternomastoid, tightly stretched over it, formed a considerable prominence during life. The rhomboid ligament was ruptured as well as the capsule of the joint. In this injury, treatment has hitherto been found unsuccessful in curing the displacement, but a good use of the arm may be anticipated.

Dislocation of acromial end of clavicle, or dislocation of the acromion.

Dislocation of the acromial end of the clavicle takes place usually in the upward direction, i.e. the clavicle lies upon the acromion process. If we follow the nomenclature of Messrs. Flower and Hulke we should call this a dislocation of the acromion process of the scapula downwards. It is believed to be caused in almost all cases by violence applied directly to the scapula, which is relatively by far the more movable bone.

The accident is unmistakeable. The shoulder is depressed, the arm apparently lengthened; there is pain in raising the arm, voluntary motion is very limited, and the prominence of the acromial end of the clavicle is easily felt. The deltoid is considerably flattened, in consequence of the arm falling or being pressed downwards, by which the fibres of the muscle are pulled down. Reduction is not difficult. It is accomplished by drawing the shoulder back, while the dislocated end of the clavicle is pushed downwards; but the bones easily slip away again. The shoulder must be well raised, with a pad in the axilla, and a compress or truss placed on the outer side of the clavicle. Some little displacement will not seriously incommode the patient afterwards. The opposite dislocation, viz. that in which the acromion lies above the clavicle, is very rare. It must be treated on the same general principles.

As surgical curiosities cases are spoken of in which the outer end of the

[1] See the account of a characteristic case by Mr. Hulke, in the 'System of Surgery,' 3rd ed. vol. i. p. 970.

[2] 'Dublin Journal of Med. Science,' Dublin, 1872.

clavicle has been thrown beneath the coracoid process as well as the acromion,[1] and cases in which the clavicle has been dislocated simultaneously from both its articulations.[2]

Dislocation of the shoulder.

Dislocation of the head of the humerus takes place usually in one of three directions—downwards, inwards, or backwards. A few cases of dislocation upwards have been described, and one of them was dissected by myself, but the injury is a very rare one.

The common dislocation is downwards, or into the axilla; but the position of the bone is not usually directly below the glenoid cavity, as would be inferred from Sir A. Cooper's language, and as he no doubt believed, but rather internal to it, though still in the axilla, and somewhat below its natural level. Hence the dislocations into the axilla are divided into two varieties —the *subglenoid*, or that directly downwards, and the *subcoracoid*, or that downwards, forwards, and inwards.

The latter is the common dislocation of the shoulder,[3] the subglenoid being decidedly more rare. The dislocation inwards, 'below the pectoral muscle' of Sir A. Cooper, or 'subclavicular,' as it is now usually termed, after Malgaigne, and that backwards 'on the dorsum scapulæ,' or 'subspinous,' are very rarely met with.

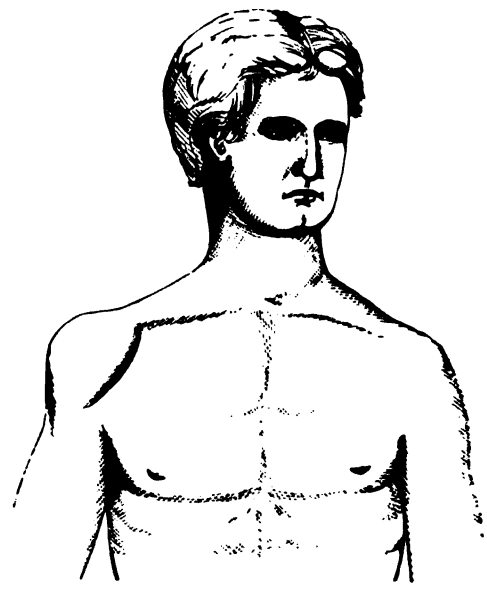


FIG. 88. Dislocation of the shoulder. An imaginary sketch, showing the usual appearance in the axillary dislocation. In the dislocation inwards, or beneath the pectoral muscle, the prominence of the shoulder will be more marked; and the head of the humerus will form a considerable prominence in the situation of the furrow between the deltoid and pectoralis major.—See A. Cooper, 2nd ed. pl. xxviii. fig. 42.

There are certain symptoms common to all dislocations of the humerus, viz. a loss of the natural rounded shape of the shoulder, a change in the direction of the axis of the humerus, an increase amounting to between one and two inches in the vertical measurement of the shoulder and axilla, loss of the power of voluntary motion, and resistance to passive movements in certain directions.

1. Dislocation downwards, or into the axilla (subcoracoid and subglenoid).

1. In the dislocations into the axilla the acromion is prominent and the deltoid flattened. The subcoracoid form of this dislocation is shown in Fig. 89. The head of the bone usually lies immediately below the coracoid process in front, internal to, and rather lower than its natural situation. In other cases the head of the bone is thrown further inwards, so as to rest more on the venter of the scapula than on the upper part of its neck, as it does in the usual subcoracoid dislocation (Fig. 90). This is described by Malgaigne as a separate

[1] 'System of Surgery,' 3rd ed. vol. i. p. 972. [2] 'Gaz. des Hôp.' 1859, No. 33.

[3] According to Messrs. Flower and Hulke thirty-one out of forty-one preparations of dislocation of the shoulder preserved in museums, and forty-four out of fifty recent cases, were found to be of this form.

form, under the name of 'intracoracoid' dislocation; but I do not see any object in separating it from the other, and I much doubt whether the cases could be diagnosed from each other during life. Mr. Flower points out that



Fig. 89. Subcoracoid dislocation (after Flower).



Fig. 90. Intracoracoid dislocation (after Flower).

in old unreduced dislocations of the purely subcoracoid form the newly-formed cavity for the head of the bone will trench on the old glenoid fossa, and will also be formed partly by the coracoid process, and that such specimens have often been described as partial dislocations. In the intracoracoid form the new cavity is independent of the glenoid fossa, and the coracoid process is not usually affected. In the subglenoid dislocation (Fig. 91) there is a more considerable interval between the coracoid process and the head of the bone, which latter is also more prominently felt when the fingers are thrust into the axilla. In both forms the arm is directed away from the side, but more so in the subglenoid;[1] it usually appears lengthened, and sometimes is really so, especially in subglenoid dislocations. In the subcoracoid this elongation is usually proved by measurement to be only apparent, being due to the dropping of the affected shoulder; sometimes the arm is even shortened; there is often considerable pain from pressure by the dislocated bone on the nerves of the brachial plexus, especially the



Fig. 91. Subglenoid dislocation (after Flower).

[1] Mr. Hulke (op. cit. p. 978) refers to a very rare variety of subglenoid dislocation—luxatio erecta—in which the arm is pointed upwards.

circumflex, which in some cases is so much injured that the deltoid muscle does not recover its functions after the reduction of the dislocation; and in rare cases there is congestion or even œdema from pressure on the vein. The arm can be moved backwards and forwards, but cannot be lifted or brought to the side. The great tuberosity of the humerus is said to be often torn off, and sometimes drawn into the glenoid cavity.

The two forms of dislocation may be regarded as varieties of the same injury, in which the head of the humerus has been driven through the lower part of the capsule, and in the subglenoid form has been arrested by the inferior costa of the scapula; while in the subcoracoid it has been drawn up by the muscles under the coracoid process.



FIG. 92. Subcoracoid dislocation of the humerus with fracture of the great tuberosity. *a*, The Acromion; *b*, The tendon of the biceps, just above which is seen a portion of the empty glenoid fossa. *c*, The coracoid process. The head of the humerus lay directly below this, but has been drawn outwards in order to show the fragment of the great tuberosity; *d d* shows the fragments of this process along with the capsule of the joint. A rod is passed between the coracoid process and the head of the bone, under the subscapularis muscle, and another on the outer side under the tendon of the infraspinatus, below which is seen a portion of the teres minor muscle. The patient was killed on the spot by a fall. The preparation is in the museum of St. George's Hospital.

The usual causes of dislocation into the axilla are either direct blows or falls on the shoulder, or a fall on the elbow or hand when extended, by which the lower end of the bone is violently raised and its head thrust against the lower part of the capsule. Muscular actions of the same kind (as in raising the arm to strike a blow) have been known to produce it, especially when the shoulder has been dislocated before. I have seen it produced (and for the first time) while the patient was lying in bed in the hospital.

2. Dislocation inwards (subclavicular).

2. In the dislocation inwards (subclavicular) (Fig. 93) the head of the bone usually makes a considerable projection on the front of the chest, below the middle of the clavicle, and usually can easily be felt, though it is said that sometimes it lies deeply in the subscapular fossa. The head of the humerus cannot be felt from the axilla, though some part of the shaft may; the arm is less separated from the side than in the axillary dislocations. The causes of this dislocation are the same; in fact, it is regarded as a variety of the common dislocation, in which from some unknown reason the head of the bone has been drawn further inwards than in the ordinary subcoracoid dislocation. There can be no doubt, however, of the accuracy of Mr. Flower's opinion, that most of the cases described as 'dislocations beneath the pectoral muscle' would now be classed as 'subcoracoid.' The true subclavicular dislocation, in

which the whole head of the bone lies internal to the coracoid process, is very rare.

3. Dislocation backwards (subspinous)

3. The dislocation backwards (subspinous) (fig. 94)[1] is a well-marked injury, in which the head of the bone forms a considerable prominence on the dorsum of the scapula, and a considerable depression is left beneath the coracoid process. The arm is usually rotated inwards, pressed closely to the side, and the elbow thrown forwards. It is caused by direct violence, or by falls on the elbow when advanced, or by violent twisting of the arm inwards.

4. Dislocation upwards (supracoracoid)

4. The dislocation upwards (supracoracoid) can only occur after fracture of the coracoid or acromion process (usually the former); it is caused, I believe, always by direct violence, applied in the upward direction—the head of the bone lies in front of the clavicle, immediately under the skin.[2]

Diagnosis.

The rarer forms of dislocation of the shoulder present usually no difficulties of diagnosis; what follows, therefore, relates mainly to dislocations



FIG. 93. Subclavicular dislocation (after Flower).



FIG. 94. Subspinous dislocation (after Flower).

into the axilla, though here, again, the errors which are unfortunately common are more often the result of haste than of any real difficulty in the diagnosis.

The flattened shape of the shoulder and prominence of the acromion process are usually very characteristic of the injury, and so is the increase in the vertical measurement around the armpit. Dr. F. Hamilton[3] has pointed out two diagnostic signs between dislocation and all the other injuries of the shoulder, which will be found useful in all cases where swelling is not very great. 1. If in the healthy state, or whenever the head of the bone is in the glenoid cavity, a rule be laid on the outer side of the arm, touching the elbow and shoulder, it will be distant from the acromion process at least half an inch, generally an inch or more. In any form of dislocation, on the contrary, the

[1] Some authors divide these backward dislocations into subacromial and subspinous, but the only difference is in the extent of the displacement, and the distinction seems superfluous.

[2] See my paper in the 'Med.-Chir. Trans.' vol. xli. p. 447.

[3] See 'London Med. Record,' April 21, 1875.

rule will touch the acromion. 2. If the surgeon stands behind the patient and places the forefinger and thumb on each side of the acromion process just external to the joint with the clavicle, the forefinger in front and the thumb behind, and then carries them vertically downwards, the tip of the finger will rest on the centre of the front of the rounded head of the humerus, while the thumb will also feel its posterior part, indistinctly at first; but if the elbow is thrown forwards and the arm rotated, the head of the bone will strike the thumb more plainly. This is the case when the head of the bone is in the socket; but if dislocation exists the head of the humerus cannot be felt by the thumb thus placed.

Cases occur in which, from paralysis of the deltoid muscle, the shoulder has the same shape as in dislocation; but when this is the result of infantile paralysis the history is different; and even when the paralysis follows on a dislocation (from lesion of the circumflex nerve) the surgeon may easily satisfy himself that the dislocation has been reduced, by the absence of any prominence in the axilla, by the freedom of passive motion, and by the vertical measurement round the shoulder—which in unreduced dislocation is greater than on the sound side—while in paralysis it is equal or less; and the same remarks apply to wasting of the deltoid after lesion of the circumflex nerve from other causes.

From fracture of the surgical neck of the humerus dislocation may be distinguished by the more pronounced flattening of dislocation, by the different shape of the bone which is felt projecting in the axilla, and by the crepitus which is felt in cases of fracture when the arm is reduced to its natural position, such reduction being usually very much easier in the fracture than in the dislocation, while the displacement is also easily reproduced. The higher up the fracture is, the more it is impacted, and the longer the time which has elapsed since the accident, the more difficult does the diagnosis become; nor is it always by any means easy to satisfy oneself whether there is some fracture of the glenoid cavity or neighbouring part of the scapula in cases which at first sight seem pure dislocations. The difficulty is increased by the effusion of fibrine into the sheaths of the tendons and cavity of the joint which usually follows on unreduced dislocation, and which gives rise to a sensation of crepitus very hard to distinguish from that of fracture. There are few practical surgeons who have not had to confess the great difficulty of pronouncing a definite opinion in such cases.

The diagnosis may, again, be complicated by fracture either of the scapula or of the humerus. In a former section (page 237) I have discussed the question, raised by Sir A. Cooper, as to the probable frequency of fracture running through the neck of the scapula and leading to such displacement of the glenoid process along with the humerus as may simulate dislocation. But exclusive of such injuries, in which there is no dislocation, there can be no question that in some cases where dislocation does exist there exists also fracture of a portion of the glenoid cavity, or of the coracoid process, or of the great tuberosity (Fig. 92), or possibly some other part of the upper end of the humerus. Dislocation, complicated with fracture of the glenoid cavity, will produce, as Malgaigne has shown, many of the symptoms which Sir A. Cooper attributed to fracture of the neck of the scapula; and it is, as far as I can see, indistinguishable from the fracture of the anatomical neck of the bone, described by Lotzbeck; but it does not separate the coracoid process from the rest of the scapula, and therefore may be distinguished (though not without difficulty) from the fracture of the surgical neck of the scapula which Sir Astley so clearly describes. Fractures of the coracoid process or of the great tuberosity

Dislocation complicated with fracture.

produce crepitus, but do not cause that insecurity of reduction which is so marked a feature in fracture of the neck of the scapula, and in dislocation complicated with fracture of the glenoid process. The fracture in these latter cases is an unimportant complication, only necessitating longer confinement of the arm. When dislocation is complicated with fracture of the shaft of the bone the injury is a much more serious one, since reduction is often impossible; and the nearer to the joint the fracture is, the greater is the difficulty. Nor is it always easy to recognise the real nature of the injury at the time. Much care, therefore, ought to be bestowed on the examination of every case of fracture high up, in order to ascertain by careful exploration of the axilla that the head of the humerus is in its place. Should dislocation be detected the patient must be brought into a condition of complete anæsthesia, and all available means used to manipulate the dislocation into position. If this attempt fails then the fracture must be set in such a position as will best restore the shape of the humerus; and in a month or six weeks, when consolidation seems to have far enough advanced, reduction must be attempted, much caution being, of course, observed not to re-fracture the bone.

Reduction.

There are numerous methods of reducing these dislocations, and those methods seem at first sight so different from each other as to lead the student to suppose that the force is applied in one in just the opposite direction to the other. For instance, in the common method, with the heel in the axilla, the arm is pulled directly downwards, towards the patient's feet, while in another method it is pulled directly upwards, above his head. But Mr. Skey[1] has shown that the mobility of the scapula to a great extent, at any rate, neutralises these differences, and that in all the plans of reduction the arm is pulled in a direction more or less perpendicular to the plane of the glenoid cavity.

The best plan, and the most usual one, is to place the patient in the horizontal position. The surgeon sitting down on the edge of the bed or sofa on which the patient lies, puts his heel (unbooted, of course) into the axilla and presses the head of the bone upwards and outwards with it, while he pulls on the hand and wrist, slightly rotating the arm if necessary.[2] The dislocated bone generally goes in with a snap, and the natural appearance and mobility of the joint are at once restored. Recent dislocations are generally reduced easily enough, especially if the involuntary resistance of the muscles is obviated by calling off the patient's attention, or by making him believe that the proceeding is one of exploration only, when by a sudden movement the bone may generally be slipped back; but if the patient is unusually timid (and especially if it be a female), or a very muscular person, or if there is much pain in the part, or unsuccessful attempts have been already made, it is better to induce anæsthesia, which very much facilitates the proceeding.

Another and a very good method is to lay the patient flat on the floor, or with his head to the foot of the bed or sofa, stand behind his head, steady the scapula with the left hand, and pull the dislocated arm in a line with the patient's body; i.e. in a direction which if he were standing would be vertically upwards; or to place the patient, sitting on the ground, in front of a chair or sofa, on which the surgeon stands and steadies the scapula with his foot, while pulling the arm vertically upwards.[3]

[1] 'Operative Surgery,' 2nd ed. p. 105.

[2] If necessary, in old dislocations a jack-towel can be fixed on the arm, by a clove-hitch, above the condyles of the humerus, on which the surgeon and his assistants can pull. This is hardly ever required, however, in recent dislocations.

[3] See Lowe, 'St. Bartholomew's Hospital Reports,' vol. vi. p. 4.

Sir A. Cooper used sometimes to employ downward traction on the arm, the patient being seated in a chair, and the surgeon putting his knee in the axilla; but this method is much inferior to the two preceding.

Reduction by manipulation.

Sometimes a sort of combination of these two methods succeeds at once, and with little or no pain or force. The surgeon steadies the shoulder with his left hand and supports the arm with his knee; while he raises, rolls inwards, and slightly pulls on the dislocated arm, pressing the head of the bone at the same time outwards and upwards with his left hand. The head of the humerus, thus disengaged from the scapula, will slip into its socket by the action of the muscles. Some authors speak of the efficacy of circumduction, 'the arm being made to describe a half-circle over the face and head;' and other surgeons describe the manipulation method somewhat differently.[1] Kocher[2] describes a method of manipulation which is, I believe, the best in use. It has been tried at University College Hospital in several recent cases with complete success,[3] and I used it very successfully in the case of an old woman with unreduced dislocation of nine weeks' standing. Kocher also refers to thirteen successful cases of old dislocation, two of them being of four months' standing. The proceeding is very simple and may be thus described: The surgeon stands or sits beside his patient. The elbow is pressed to the side, the forearm flexed, and rotated outwards till it stands at right angles with the body. The head of the bone will then often roll into the glenoid cavity. If it does not, the elbow is to be raised, by flexing the arm to an angle of 45°, and then rotated inwards till the hand is brought to the opposite shoulder. Anæsthesia is required only in old dislocations, or very nervous persons. The method is recommended by its author only in subcoracoid, but was used successfully in a patient of Mr. Heath with subglenoid, dislocation. For the theory of its action I must refer to Kocher's paper. It is a plan which is well worth trial, especially in cases complicated with fracture of the ribs or other injuries.

Mr. Kelly describes, in the 'Dublin Journal of Medical Science' for September 1882, a method which he has found successful when others have failed. The patient is drawn to the side of a firm horizontal couch, with the dislocated shoulder on its edge; the surgeon, standing at his side, so that his own trochanter may be a little above the patient's shoulder, winds the arm round his own pelvis, fixing the hand by pressing it firmly against the crest of his ilium, and then twists half round, so as to turn his back to the patient. Of course the patient's body can be held or steadied if necessary.

Another and a very powerful method is thus described by Mr. Flower: 'The patient is seated on a high chair, which is placed about two feet from an open doorway. The surgeon, having his back against the doorpost, places one foot upon the side of the chair, and, with his knee pressed into the axilla, and both hands upon the shoulder, steadies the patient's body. A jack-towel is then fixed by a clove-hitch-knot to the patient's arm, just above the elbow; and by its means two or more assistants, placed on the other side of the doorway, make steady extension vertically outwards.'

Reduction by pulleys.

As a general rule it is only in neglected dislocations that pulleys are needed.[4] The patient is brought fully under anæsthesia and placed either in

[1] Bryant, op. cit. vol. ii. p. 328. Pirrie, 'Principles and Practice of Surgery,' 2nd ed. p. 319. Gordon, op. cit.

[2] 'Trans. Internat. Med. Congr. 1881: Surgery,' p. 214.

[3] 'Lancet,' April 14, 1883.

[4] It may be well to remind the reader that in the system of pulleys in common use, when parallel strings pass round a number of pulleys, the force applied is multiplied by the number of strings on the block, or twice the number of the pulleys.

the sitting or reclining posture, the body fixed to a firm staple on the side opposite to the dislocation by means of a leather bandage, which encircles the shoulder and fixes the scapula, its two ends being secured by a cord to the staple. The arm should be bandaged from the hand, and the pulleys attached to a leather collar fitted to the arm above the condyles of the humerus. Traction is made in the horizontal direction, with gradually increasing force, and when the surgeon finds that the head of the bone is moving he tries to manipulate it into the glenoid cavity. In cases of long standing it is well to begin by breaking down all adhesions, as far as possible; and if any tendons can be found on the stretch which seem to oppose reduction, they may be subcutaneously divided a few days before the attempt is to be made. Since the introduction of chloroform the limit assigned by Sir A. Cooper to the time at which attempts at reduction may be made has been much extended. That limit was fixed by him at three months; but cases have now been recorded in which reduction has been effected even as much as two years after the accident.[1] The propriety of such attempts must, however, depend in a great measure on the amount of inconvenience which the patient complains of. There can be no question that the necessary force cannot be applied without danger. The artery has occasionally been torn in reducing a dislocation, though, as Mr. Callender has shown,[2] the cases of which we have a complete record are very few, and in a large proportion excessive violence was used by unskilful persons.[3] The vein has also been ruptured—though this is even more rare—or the humerus fractured. It is true that these grave injuries are not common, especially when the patient is not advanced in age and the arteries are healthy, yet no one can have used or seen used the force which even prudent surgeons are obliged to employ in such cases without feeling that it must involve some risk of immediate danger or subsequent inflammation; and the consideration which Sir A. Cooper puts forward is a very grave one—whether the arm is really likely to be useful after reduction. It must be remembered that Sir Astley did not deny the possibility of reduction later than three months; he even says he had seen examples as late as six months; but he says 'the injury done in extension was greater than the advantage received from reduction.' And I would remark, that in the published accounts of cases of late reduction we are, as a rule, left quite in the dark on this head. It is, therefore, only in cases where the unreduced dislocation is a source of much misery to the patient that I should be disposed to make the attempt. After unreduced dislocation, as a general rule, the limb acquires very considerable usefulness—the patient regaining the power of raising the arm nearly to the horizontal line; the parts accommodate themselves to their new position, and there is neither pain nor œdema. Sometimes, on the other hand, there is great pain and great loss of the use of the limb. In such cases it might possibly be justifiable to remove the head of the bone, and an interesting case in which subcutaneous section of the neck of the humerus was successfully performed by Dr. Ewing Mears, of Philadelphia, will be found mentioned by Mr. Adams in the 'Brit. Med. Journ.' Jan. 20, 1877.

Limit of time for reduction.

After reduction the arm should be bandaged to the chest, the hand and forearm being kept inside the clothes, so that no movement is permitted; and

[1] See on this subject an interesting paper by Mr. Brodhurst in 'St. George's Hospital Reports,' vol. iii. p. 67.

[2] 'St. Bar. Hospital Reports,' vol. ii. p. 96.

[3] There seems no doubt of the truth of an account of a case which occurred in France a few years ago, in which an old woman's forearm was *pulled off* in an attempt to reduce a dislocation.

it is well to place a pad in the axilla. After a week of this rigid confinement the patient may be instructed to carry the arm in a sling for another ten days or a fortnight, and may then be allowed to make some use of it; but he should be careful to avoid violent or sudden exertion for a considerable time, at least a quarter of a year. Renewed dislocation is very common, and each time the joint is dislocated it becomes less secure.

Compound dislocation.

Compound dislocation of the shoulder is a rare injury, and a very serious one. 'It still remains to be determined by experience,' says Mr. Hulke, 'whether under such circumstances reduction, or resection of the head of the bone, is the safer method of treatment.' My own feeling would be decidedly in favour of reduction in healthy persons, and in the absence of complications; but where the patient was weak or old, or the exposed bone injured, or the parts much lacerated, it would probably be better to saw off the exposed head of the bone. A good instance of the success of reduction is to be found in a case related by Mr. Holden in 'St. Barth. Hosp. Reports,' vol. xii. p. 41. The patient was 19 years of age. The head and neck of the humerus subsequently exfoliated, but the patient had a very useful limb. References to other cases will also be found in Mr. Holden's paper.

Partial dislocations.

We do not know very much about partial dislocations of the shoulder. The case so frequently quoted, described by Mr. Soden of Bath,[1] as partial dislocation upwards, with rupture of the tendon of the biceps, was, there is every reason to believe, an instance of chronic osteoarthritis, supervening on a sprain. Such displacement and disappearance of the tendon is constant in that disease.[2] Mr. Flower and Mr. Hulke 'are disposed to agree with Dr. R. Adams in denying that the case of partial luxation of the head of the humerus, as the result of accident, has ever been satisfactorily proved, either in the living or the dead subject.' Mr. Le Gros Clark, however, has published a case of partial dislocation of the head of the bone backwards, which, I think, must be allowed to be conclusive. The patient, a spare, elderly man, had slipped in getting over a hurdle, about two hours previously. There was no effusion into the joint; the movements of the joint were almost lost; the head of the humerus was 'in its natural position as regards height, but its projection in front of the acromion was absent, and there was an abnormal prominence at the back of the joint, behind and below the acromion. On gently raising the elbow from the side and rotating the humerus, its head slipped into the glenoid cavity with an audible click, and the joint at once resumed its normal form and appearance—the patient exclaiming that he lost his pain as soon as he felt and heard the bone go back.'[3] The thinness of the patient and the absence of any effusion left no doubt of the position of the bone; and since a week's rest in a great measure restored the use of the joint, Mr. Clark concludes that there could have been no laceration of the capsule or tendons. The case, also, which is described by Mr. South[4] shows very plainly indeed the possibility of partial dislocation of the head of the humerus forwards, at least when, as in that case, the coracoid process is

[1] 'Med.-Chir. Trans.' vol. xxiv. p. 212.

[2] See the criticism of Mr. Soden's case, by Dr. R. Adams, on 'Rheumatic Gout,' 2nd ed. 1873, pp. 140 et sqq. The possibility, however, of displacement of the long tendon of the biceps is proved by a specimen in the Museum of St. Bartholomew's Hospital. See Chap. XXV. where the general subject of dislocation of tendons is treated.

[3] 'St. Thomas's Hospital Reports,' New Series, vol. v. 1874, p. 145.

[4] 'Med.-Chir. Trans.' vol. xxii. p. 100. Dr. Stephen Smith, of New York, recently recorded two cases which he considers analogous to that of Mr. Clark's patient. 'New York Archives of Clin. Surg.' i. 33.

fractured—a condition which Mr. South regarded as essential to the occurrence of partial dislocation in this direction. In that case a depression existed behind and below the acromion, which led to the supposition that some displacement of the head of the humerus or fracture of the neck of the scapula existed, but still the roundness of the shoulder was not lost. On making certain manipulations the head of the humerus was felt to move backwards, and then the appearance of a pit ceased. The patient having died two days afterwards from the effects of other injuries, the head of the bone was found in its proper position; there was a rent or slit about an inch long in the capsular ligament, through which the cartilage covering the humerus was exposed. On lifting up the shaft and pressing the head of the humerus forwards it was seen to be 'partially thrown forwards and over the front edge of the glenoid cavity, so that it became fixed, and behind it the depression below the acromion appeared, in consequence of the sinking of the tendons of the infra-spinatus and teres minor muscles into the glenoid cavity, from the altered position of the head of the bone, which, however, did not protrude through the slit in the capsule, although it was there more distinctly visible.'

From these cases the conclusion would be that partial dislocation of the shoulder is, in itself, a trifling accident, easily remedied, and not liable to produce any permanent mischief; and that it is a very rare injury, though its occasional occurrence is undeniable; and very possibly it may be overlooked, from the head of the bone having slipped back before the patient is seen.

Dislocation of the *elbow* is a tolerably common accident, taking place usually in youth, as the result of a fall or wrench, or sometimes of a blow. Dislocation of the elbow.

If diagnosed at once and properly treated, the injury is one in which a good result may be confidently expected. But it is singular how very often cases are met with in which the accident has been overlooked, and then the dislocation becomes rapidly irreducible. I cannot remember to have seen such a dislocation reduced after six weeks, and I have known cases in which mischief has been done by the attempt.[1] It is charitable to suppose that in some such instances of mistaken diagnosis the nature of the injury has been masked by an unusual amount of contusion and inflammation; but I cannot help saying that no such explanation could be given of others, and that the patient appeared to have lost the use of his joint from the negligence of the surgeon. The practical inference is that in all injuries affecting the elbow the surgeon should study minutely the relations between the various prominences of the bones—viz. the internal condyle, olecranon, external condyle, and head of the radius—and should not affect to give a diagnosis until he has observed at any rate the following points: 1. Is there any transverse fracture of the humerus? i.e. on grasping the condyles in one hand and the lower part of the shaft in the other, can they be made to move or crepitate on each other? 2. Is there any longitudinal or partial fracture of the lower end of the humerus? i.e. are the condyles unnaturally separated from each other, can they be made to crepitate when grasped by the finger and thumb of opposite hands and moved on each other, or is there a movable fragment of either (probably the internal) condyle without any fracture into the joint? 3. What is the distance between the olecranon and the internal condyle on the injured as compared with the sound side? 4. Is the olecranon itself fractured? 5. Does the head of the radius

[1] Dr. Sayre relates two cases in which dislocations of fourteen and sixteen weeks' standing were reduced by the aid of subcutaneous section of the triceps tendon. 'Western Lancet,' Jan. 1873.

move with its shaft on passive rotation, and is it in the normal relation to the external condyle? 6. Do the axes of the two bones of the forearm correspond in direction? 7. Is the axis of the forearm natural, relatively to that of the arm?

I allow that in some cases some of these questions may not admit of an immediate answer, from the amount of swelling present, but usually they do, or at any rate the most important of them. If they do not, the diagnosis of the case should be deferred, and the surgeon should not be ashamed to say that he cannot at present tell what the nature of the injury is. Unfortunately, we constantly meet with cases in which confident opinions are given on insufficient data, to the great injury of the surgeon's reputation, and, what is worse, to the permanent detriment of his patient, who remains satisfied perhaps that his arm is only 'sprained' till it is too late for the overlooked dislocation to be reduced, or the fracture to be set, and the motions of the joint restored.

Dislocation of both bones backwards.

The commonest dislocation of the elbow is that of both bones of the forearm backwards. The radius and ulna maintain their normal relation to each other, the orbicular ligament remaining attached to the sides of the small sigmoid notch. The olecranon projects considerably; the arm is semi-flexed (see Fig. 82, p. 243); the head of the radius may perhaps be felt at the usual distance from the olecranon; but the distance between the tip of the olecranon and the internal condyle very greatly exceeds that on the other side. There is a great rounded prominence in the bend of the elbow, or rather, perhaps, pushing the fold of the elbow downwards, so that the forearm seems shortened. There is commonly no crepitus; unless, perhaps, in some cases where the projection of the internal condyle has been chipped off.

Most of these distinctive characters of the backward dislocation of the elbow can be clearly traced on Fig. 95, taken from an injury of this kind which I accidentally found in the body of a seaman who died from a different cause.

By these signs the dislocation can be readily distinguished from the injury which most resembles it—i.e. a fracture of the lower end of the humerus just above the condyles, in which there is often displacement of the forearm backwards, with semiflexion, projection of the olecranon and tendon of the triceps, and a prominence near the bend of the elbow. But in the fracture, though the olecranon projects, measurement will show that it is at the same distance from the internal condyle as on the sound side—the prominence which is formed by the other fragment of the humerus is not in or below the bend of the elbow, but above it; and has not the rounded outline of the head of the bone. And the diagnostic sign on which Sir A. Cooper laid so much stress is of great value, that reduction, though easy, is very insecure, the displacement being immediately reproduced. Also when the parts are reduced crepitus may be felt. There is not, therefore, ordinarily any real difficulty in diagnosing the two injuries. (See p. 243 for a fuller account of the fractures near the elbow.)

Such are the symptoms and the pathological anatomy of the complete dislocation backwards. But from the less amount of flexion, and from the great ease with which reduction is effected, it is believed that in many dislocations the displacement is not complete—i.e. the coronoid process is not carried fairly into the olecranon fossa, but rests on the trochlear surface, from which, of course, any slight traction will replace it into its natural position.

Dislocation, with fracture of the

Again, it is believed by many surgeons that this displacement of both bones backwards is often accompanied by fracture of the coronoid process of the ulna, as was the case in the remarkable pair of specimens one of which is represented

in Fig. 96. I am not prepared to speak confidently on this point. I have met with one case in which during life all the symptoms of the injury were very plain—dislocation of the bones backwards, very easily reducible, some crepitus after reduction, and constant reproduction of the displacement. But in ordinary cases the reduction when once effected is so secure, and passive movement of the ulna round the trochlear surface of the humerus after reduction is so smooth and uninterrupted, that it is difficult to believe in the existence of any such fracture. Nor is there any anatomical confirmation of the doctrine which affirms the frequency of fracture of the coronoid process, as far as I know. coronoid process.

If dislocation backwards remains unreduced it leads to very lamentable loss of the motion of the arm. In the preparation, Fig. 95, there remains no movement of flexion and extension whatever, the coronoid process being wedged into the olecranon fossa and tightly bound down there by inflammatory adhesions, the brachialis anticus torn away, and the biceps having no means of Reduction.



Fig. 95. Old dislocation of both bones of the forearm backwards. From the body of a man who died from other causes. Nothing is known about the accident. *a* shows the olecranon process projecting, with *c*, the triceps muscle attached to it. *b*, the radius, the head of which has formed a new articular cavity for itself on the back of the external condyle and enjoyed some little mobility. The coronoid process of the ulna was lodged in the olecranon fossa, and was almost immovable, so that there seems to have been no power of flexion and extension. *d* points to the biceps muscle, which remained attached to the radius. *c*, to the brachialis anticus, which had been torn away from the coronoid process. The principal part, here shown, was fixed to the humerus, so that its action had been abolished. Some fibres, however, were also attached to the ulna below its natural insertion.—From a specimen in the Museum of St. George's Hospital, Ser. i. No. 108.



Fig. 96. Dislocation of both bones of the elbow backwards, with fracture of the coronoid process of the ulna. *a* shows the fragment of the coronoid process, which remains connected to the humerus. *b*, the surface of the ulna, from which it has been separated. *c*, the upper end of the radius displaced backwards, as was also the ulna. A vertical fracture traversed the head of the radius. The specimen in the Museum of St. George's Hospital (Ser. i. No. 111) was taken from the body of a man who, while at work on some repairs in the Hospital, fell from a great height into the courtyard, and was taken up dead. There was exactly the same injury of the elbow on both sides, even to the longitudinal splitting of the head of the radius, showing that he must have come down with both hands on the ground in precisely the same position.

acting on the radius, which is itself firmly attached to the ulna. All that the patient seems to have preserved is a little rotation of the radius in a new cavity which it had formed on the outer condyle. But when treated early reduction is generally very easy. Many dislocations of the elbow slip in on the least traction being made on the hand, probably, as hinted above, because the coronoid process is not fairly lodged in the olecranon fossa. If the coronoid process be fractured no obstacle to reduction can possibly exist. And even in the complete dislocation steady traction on the hand, combined, if necessary, with slight rotatory movements, will almost certainly disengage the coronoid

process, which can then easily be slipped round the trochlea by bending the arm. An anæsthetic is generally unnecessary, but may be administered if the patient is unusually timid, or if attempts without it have failed. If the surgeon have no assistance he generally places his knee on the projecting humerus, to make counter-extension, steadies the arm with his left hand, grasps the forearm with his right, and pulls it downwards, and then, when he feels the displaced bones move, he bends the forearm sharply, and they slip into place.

In old dislocations either the pulleys must be put on in order to bring the bones of the forearm downwards, and when they are thought to be disengaged reduction is attempted by acute flexion; or, after all adhesions have been broken down by various movements, the case is treated as a recent dislocation. Care must be used in such cases not to fracture the bones.[1] Section of the triceps tendon may be useful in such cases, as in those referred to on p. 268, footnote.

Dislocation of the head of the radius only.

The form of dislocation which is most frequent next to that of both bones backwards is that of the head of the radius only, the ulna remaining in its place. This occurs either on the back (Fig. 97) or the front (Fig. 98) of the external condyle. Careful examination can hardly fail to detect in the dislocation backwards the projection of the displaced head, and the change in the axis of the bone, which are so well shown in the figure; in the dislocation forward the loss of the head of the radius from the part where it should be felt; and in both the total loss of the power of voluntary pronation and supination, and the almost total loss of passive motion. If the injury be overlooked the patient will lose more or less completely the power of turning the hand, except by the comparatively awkward device of rotating the humerus. The dislocation of the head of the radius is remarkable as being one of the few which are not uncommon in early life, as Fig. 98 shows. It has been known to be produced by traction made by the accoucheur on the child's hand in delivery. The forward dislocation is said by Fergusson and by Hulke to be the more common of the two.



FIG. 97. Dislocation of the head of the radius backwards. The head of the radius is much altered in form. The orbicular ligament had been carried away along with the head of the radius, and had taken an attachment to the humerus on either side of the dislocated head, so that the motions of pronation and supination were abolished. The outer condyle of the humerus is much changed in shape from deposit of new bone. The ulna is perfectly natural. Flexion and extension could be performed, through about a quarter of their natural extent. The preparation in St. George's Hospital Museum (Ser. i. No. 109) was taken from the body of a young man who had received a blow on the elbow about two years previously, and noticed the change in the shape and motion of the joint next day.

In its reduction the forearm should be flexed so that the biceps may be relaxed, and then while an assistant manipulates the hand as directed, so as to approximate the head of the radius towards the ulna, the surgeon tries to press it directly into the lesser sigmoid cavity by the pressure of his thumbs supported by the counter-pressure of the fingers on the other side of the limb.

The other dislocations are much rarer. Both bones have been found dis-

[1] Dr. Ogston, of Aberdeen, has related a case in which reduction was impossible in consequence of the end of the humerus having been driven through the brachialis anticus muscle, and believes that this is an occasional cause of irreducibility in dislocations complicated with fracture, 'Brit. Med. Journ.' Sept. 2, 1876.

located laterally, the outward dislocation being the more common. A few instances have even been recorded of dislocation forwards, the olecranon process being thrown more or less completely down to the end of the trochlear surface of the humerus and the arm elongated; or the ulna alone may be dislocated from both the humerus and radius. It would serve no useful purpose to describe minutely the characters of these rare injuries, or to dwell further on the symptoms of the fractures of the various processes which are constant accompaniments of dislocation of the elbow. Great care is necessary in the examination of every case. After reduction the arm should be kept quiet on a splint for a fortnight at least, and should then be used very cautiously.

The rarer dislocations.



Fig. 98. Dislocation of the head of the radius forwards, at the age of two years, with fracture running through the cartilaginous olecranon. The dislocation was compound, and the child died of pyæmia.—From the Museum of St. George's Hospital, Ser. I. No. 110.

When the dislocation is compound the surgeon is guided in his treatment chiefly by the amount of the concomitant lesions. If these are trifling it is better, especially in elderly persons, to reduce the bones, close the wound, and trust to early passive motion to restore some movement to the joint. If the bones are considerably injured it may be better to perform excision of the whole joint; and if the great vessels or nerves be also injured, amputation may even be necessary, though this is quite exceptional.

Compound dislocations.

The *lower radio-ulnar joint* may be dislocated; and as in this joint the radius is the movable bone, it is usual at the present day, following the analogy of the nomenclature of other dislocations, to call this a dislocation of the radius from the ulna, instead of the ulna from the radius, as Sir A. Cooper called it. The radius seems displaced forwards rather more commonly than backwards; the hand is of course displaced forwards, and the styloid process of the ulna projects backwards and sometimes comes through the skin. The opposite dislocation causes similar symptoms reversed. These injuries are caused by violent twisting of the hand. They are to be reduced by extending the hand and manipulating the radius into position. If there be a wound it must be carefully closed, and in any case the hand should be kept in splints for about a fortnight.

Dislocation of lower end of radius.

Dislocation of the *wrist* occurs almost always backwards; the bones of the carpus project on the dorsal surface of the forearm, the articular surfaces and styloid processes of the radius and ulna being felt below them. The dorsal projection gives this injury some resemblance to Colles's fracture, especially when the hand is somewhat twisted, so that the styloid process of the ulna projects; and the two injuries were generally confounded together before Colles's time; but there is no real difficulty in the diagnosis, for the position of the styloid processes in relation to each other and to the hand is an unfailing test. In the dislocation the styloid processes are on the same level, and lie much nearer to the fingers as well as much lower than natural. In the fracture the styloid process of the radius is displaced along with the hand, while that of the ulna, though prominent, is at nearly the same distance from the little finger as on the sound side.

Dislocation of the wrist.

Reduction is usually easy. It is better, I think, to keep the part quiet on

a splint for a few days at first, and then to wear the hand in a sling for about a fortnight.

The dislocation in the other direction (i.e. with the hand in front of the forearm) very rarely occurs as a traumatic lesion. Its symptoms would be the same as the above reversed.

Dislocations of the carpus.

Though the bones of the carpus are so small, and so securely locked together, yet dislocations do occur. Such as I have seen have been compound. The Museum of St. George's Hospital contains a pair of semilunar bones which were exposed in a compound dislocation of both wrists, and were removed before the wounds were dressed. The patient died from other injuries, but the parts were unfortunately not preserved. Another preparation shows dislocation of the rest of the carpal bones from the semilunar, which alone remains attached to the bones of the forearm. The scaphoid was fractured, and the fractured portion extracted through the torn dorsal ligaments. I saw a short time since a case in which the greater part of the semilunar bone came away, but the patient recovered a very useful hand. In other cases the head of the os magnum has been the protruding part. I do not think any special directions need be given for the diagnosis and treatment of such injuries. The protruding parts are generally easily replaced, and the patient usually recovers the utility of the hand; the great point is to see that the motions of the fingers are early restored.

Dislocation of the thumb.

The first phalanx of the *thumb* is comparatively often found dislocated on to the metacarpal bone. The articulating surface of the phalanx usually lies on the dorsal surface of the metacarpal bone, though a few cases of the opposite dislocation have been met with. Either may be recognised at once by the shortening of the thumb, and by the projection on the dorsal aspect of the hand, formed, in the one case, by the displaced end of the first phalanx, in the other by the prominent head of the metacarpal bone. The dislocation backwards is often very hard to reduce.

When the first phalanx is carried backwards it takes with it the two heads of the flexor brevis pollicis, and the sesamoid bones developed in them; the anterior and lateral ligaments of the joint are torn off the head of the metacarpal bone, which tears a way for itself through the fibrous tissue uniting the two heads of the flexor brevis, between which it projects as a button does out of a buttonhole (see Fig. 99). In these two conditions consists the difficulty of reducing the dislocation, viz. in the tension of the short flexor, and the difficulty of slipping the tissues forming the buttonhole over the mushroom-shaped head of the metacarpal bone. The first principle, therefore, in reducing any dislocation of the thumb which presents difficulty is to relax the short flexor, and this is done by forcibly adducting the thumb; i.e. pressing it as far as possible over to the middle line of the hand. This being done by an assistant, the surgeon takes the displaced first phalanx and places it in extreme extension, in order to relax the tissues of the buttonhole, and to push up those which form its distal part over the projecting head of the metacarpal bone. This is done by dragging the hyperextended thumb downwards, i.e. away from the wrist, and then acute flexion will restore it to its place.[1]

Such, I have no doubt, are the main obstacles to the reduction of this dislocation, and the appropriate method of obviating them. But there are prob-

[1] The difficulties attending the reduction of this dislocation, and the method of obviating them, are admirably described in a memoir by Prof. Fabbri, in vol. x. of the 'Memorie dell' Accad. delle Scienze dell' Istituto di Bologna.'

ably in some cases other causes concurring, such as the interposition of some of the torn fibres of the ligaments, or of the fascia forming the distal portion of the 'buttonhole' between the ends of the bones,[1] and possibly the interlocking of the bony projections themselves. These minor obstacles can usually be overcome by slight rotatory movements of the phalanx during extension.

As there is often need for the application of considerable force, it is important to apply some apparatus which will keep firmly in place and at the same time not cut the skin. The Indian puzzle-toy which holds the more firmly the more it is pulled upon, may be found useful; and there is a pair of forceps (called the 'American forceps'), manufactured for the purpose, with handles like those of the lithotomy-forceps, and two sheets of leather attached to the blades, which cross each other. The blades are fixed by a screw, so that they hold very firmly, while they can hardly damage the soft parts. But when



FIG. 99. Dislocation of the thumb backwards, showing how the displaced phalanx carries backwards with it the heads of the flexor brevis pollicis, and how the head of the metacarpal bone is consequently forced forward through a buttonhole opening in the tissue which unites those heads in front. The margin of this buttonhole is seen constricting the neck of the bone just above the letter *a* in the figure.—From the dissection of a dislocation artificially produced in the dead subject. After Fabbri.



FIG. 100. Reduction of dislocation of the thumb (after Fabbri). The metacarpal bone is flexed as far as possible by squeezing it towards the centre of the hand. This carries the displaced phalanx with it, and so approximates the insertion and origin of the flexor brevis pollicis, relaxing the tissue forming the edge of the buttonhole, *a*. The dislocated thumb is then hyperextended, in order to slip the upper edge of this buttonhole round the prominent head of the metacarpal bone. When this is even partially effected the muscles will draw the phalanx into position.

The tension of the fibres of the flexor brevis pollicis in the former figure may be contrasted with their relaxation in this.

such contrivances are not at hand a clove-hitch must be made of any appropriate material (the broader, softer, and stronger the better) and applied around the first phalanx, hitching against the projection of the joint. Manual extension is generally sufficient; but I had once occasion to use the pulleys successfully. When reduction has been effected some surgeons recommend that the joint be flexed and extended once or twice to disengage any of the tissues which may have slipped between the bones.

If all attempts at reduction by mere manipulation have failed, the case should be left for a time, cold being applied to combat inflammation; and if

[1] Mr. Kelly ('Dublin Journ. of Med. Sci.' May 1883) attributes the difficulty in most cases to the interposition between the bones of the anterior ligaments, or the fascia uniting the sesamoid bones in front.

renewed careful attempts have no better result, the course generally followed is to make a subcutaneous section of the parts between the skin and the displaced phalanx on one or even both sides. This is usually spoken of as 'division of the lateral ligaments;' but it really, I presume, involves a more or less complete division of the head of the flexor brevis, and is successful when the 'buttonhole' is laid open, and the metacarpal bone thus liberated. Another plan, recommended by Dr. Humphry,[1] is to introduce a blunt hook, through a small incision, beneath one of the sesamoid bones, and draw it forwards with the phalanx. I have seen both plans successfully adopted; but I believe neither will often be required if Prof. Fabbri's directions are carefully followed in the manipulation. In a case under Mr. Rouse's care, all attempts at reduction having failed, an incision was made over the head of the bone, the displaced sesamoid bone was drawn aside with a hook, and then the dislocation was easily reduced. The patient recovered the complete use of the part. This plan differs from Dr. Humphry's proposal only in the free exposure of the displaced parts; but this seems to me its great advantage, and after witnessing its complete success in this instance I should be disposed in a future case to adopt it in preference to subcutaneous sections. Finally, if all fails, the case must be abandoned, passive motion being early and sedulously practised. Cases are on record in which the thumb, though dislocated, has been very freely movable.

When the dislocation is compound, the projecting bone, which may be either the phalanx or the metacarpal bone, should be removed, and passive motion early practised.

Dislocation forwards.

Of the dislocation of the phalanx forwards, four examples are related by Nélaton.[2] One of these, though seen early and treated by some of the best surgeons in Paris, remained irreducible.

Dislocation of the fingers.

The phalanges of the fingers are rarely dislocated, but occasionally, in a fall, this injury may take place at any of the joints, the distal bone being generally thrown behind the proximal. The injury is tolerably often compound. Reduction is usually quite easy. I saw one case of old dislocation in which I found it impossible; but the patient was not in a condition to explain the circumstances to me, and I believed that it had been neglected. After the reduction the finger should be bound up for a few days, to prevent any use of it until the torn ligaments have consolidated, and then careful passive motion should be given.

[1] Humphry on the 'Skeleton,' p. 434.

[2] 'Path. Chir.' vol. ii. p. 23.

CHAPTER XV.

INJURIES OF THE LOWER EXTREMITY.

Sprains. Sprains of the joints of the lower extremity are amongst the commonest injuries in surgery, especially of the ankle and knee, and in the ankle it is often difficult to decide whether there is fracture or no. The injury is often a severe one, causing great pain at the time, being accompanied probably with much laceration of the ligaments and other structures near the joint,[1] and leading frequently to prolonged lameness. Severe sprains are followed generally by a good deal of effusion into the synovial cavity, which is sometimes slow to disappear; and they often lay the foundation of permanent disease of the articulation. Hence we can hardly be too careful in our treatment of them. At first, while the active state of effusion is present, antiphlogistic measures are necessary. When it is grateful to the patient the sedulous application of cold by means of icebags is, I think, the best; but if this is not tolerated, leeches, followed by warm fomentations, or evaporating lotions, or irrigation with spirit-and-water, will best check the tendency to effusion. As soon as the patient can bear it, equable pressure, by strapping and bandage or by splints, with perfect rest, should be adopted, and is one of the most potent means of cure in such injuries. But it is important, as soon as the patient has lost all pain, or if he has not quite lost pain, yet as soon as he can bear passive motion without renewed swelling and inflammation, to commence bringing the joint into use, by cautious motion and shampooing at first, and then by more free motion of it day by day, combined with steaming and free rubbing in of oil, and to encourage the patient to exercise it as much as he can without harm. Sir J. Paget has called attention to the coldness which affects joints which have been kept too long at rest, and he cautions his readers in the following emphatic terms against the bad effects of too-protracted inaction: 'Too long rest is, I believe, by far the most frequent cause of delayed recovery after injuries of the joints in nearly all persons who are not of scrofulous constitution. In the healthy, the chronic rheumatic, and the gouty it is alike mischievous; and not only to injured joints, but to those that are kept at rest because parts near them have been injured. Mere long rest stiffens them and makes them oversensitive; cold douches and elastic restraints and pressures make them worse, and nothing remedies them but movement, whether forced or voluntary.'[2] And he points out that such cases are the most frequent examples of the class which are cured by the rough manipulation of the bone-setter, who gets a joint which has been sprained and kept too long at rest, then pretending or believing that it has been dislocated wrenches it, and tells the patient that it has been put in, and that now he may use it. The patient, finding himself able to do so, naturally believes what the quack tells him, and thinks that his surgeon has

[1] The tendons in some of these cases may be displaced from their grooves, or so loosened as to be dislocated in a subsequent accident. See Chapter XXV. Mr. Morris's article on Injuries of the Lower Extremity 'Syst. of Surg.' 3rd ed. vol. i. p. 991, contains an interesting and complete account of the anatomical lesions usually met with in sprains.

[2] 'Clinical Lectures,' p. 96.

overlooked a little caution. The real fact is, that rest of the sprained joint has been carried on too long. But this fact—though there can be no doubt of it, and every one must have had frequent opportunities of verifying it—must not lead us into the opposite error of decrying the use of complete rest in sprains, especially in the lower limb: nor into that of insisting on too early passive or active motion, which would reproduce the inflammation and much prolong the mischief. Passive motion, shampooing, &c., should be begun as early as seems prudent, but always gradually and with caution, and at first with prolonged intervals of rest.

Wounds.

Wounds of the lower extremity need not detain us in this place. The injuries of large arteries as the femoral have been spoken of above. The wounds of joints, and especially of the knee-joint, are the most striking feature in the regional surgery of such injuries. When the knee-joint is opened by a clean cut the nature of the injury is known by the escape of synovial fluid and by the effusion into the cavity. Unless a foreign body is known to be lodged, no probing or other examination is admissible. Otherwise the cut is to be carefully united, and the joint equably and firmly strapped, the limb being bandaged from the toes upwards, on a well-fitting splint, just as after the operation for removing a loose cartilage. If swelling, pain, and fever should testify to the access of acute inflammation, then the joint must be exposed, leeches very freely applied, and afterwards ice or Leiter's tubes kept on the part constantly. If the case does badly, its further progress resolves itself into the diagnosis and treatment of acute abscess in the joint (for which see the chapter on DISEASES OF THE JOINTS); but if it does well the symptoms gradually subside, and the patient recovers, usually with more or less of ankylosis, though possibly in some cases completely.

Of knee-joint.

Foreign bodies may lodge in wounds, especially of the buttock, and are frequent in the foot; but I can add nothing on this head to what has been said above p. 281.

Fracture of cervix femoris.

Fracture of the neck of the femur—a common accident in old persons of both sexes—takes place entirely within the capsular ligament of the hip-joint, or else partly or wholly external to that cavity. The former fractures are called *intracapsular*, the latter *extracapsular*.

The annexed figures will show the usual forms of fracture of the neck of the femur. The division into extra- and intra-capsular—which was made by Sir A. Cooper, and which is ordinarily followed in our schools—appears to me one of considerable importance; but another of equal, and, according to the judgment of some writers of great authority, of even greater practical value, is into the impacted and the non-impacted fractures. The series is not, of course, intended to exhibit all the varieties which are met with, but it does show those which are most clearly distinguishable from each other, and the characters of which it is important to bear in mind.

Fig. 101 is the truly intracapsular fracture which generally occurs in old age, and often from slight causes; it is usually free from impaction, and rarely found united by bone.

This fracture, however, may be impacted, and in such cases, at any rate, bony union does occur. This is shown by Fig. 107.

Fig. 102 shows the ordinary impacted extracapsular fracture which occurs both in old age and at earlier periods, in which the upper fragment (comprising the head and the whole of the neck) is driven into the cancellous

tissue of the base of the trochanter, and firmly wedged there; so that in the case from which the preparation was taken, and where the same fracture had occurred on both sides, at four years' interval, in the recent fracture the upper



Fig. 101. The common, non-impacted, extracapsular fracture of the neck of the thigh-bone.—From a preparation in St. George's Hospital Museum, Ser. i. No. 180.



Fig. 102. The common, impacted, extracapsular fracture of the cervix femoris. From a woman aged seventy-four at the time of her death, who had had fracture on one side four years, on the other five weeks, before her death, both injuries being almost exactly similar. The old injury was completely united by bone; the recent one, here shown, was firmly impacted, but the fragments separated in maceration.—St. George's Hospital Museum, Ser. i. No. 207.

fragment was so firmly wedged into the lower that it was only separated by maceration. This fracture unites always by bone.

Fig. 103, on the other hand, represents the common form of comminuted



Fig. 103. The common, comminuted non-impacted fracture of the neck and trochanters.—From a specimen (Ser. i. No. 142 b) in the Museum of St. George's Hospital.



Fig. 104. A gunshot wound, causing intracapsular fracture of the neck of the femur, in a young man (aged 25). A charge of small-shot passed through the hip-joint, from a very short distance, at the back of the limb ('balled,' according to the common expression), cleanly dividing the femur. It will be noticed that the back part of the bone is notched by the shot in two or three places.—From a specimen in St. George's Hospital Museum, Ser. i. No. 136.

fracture of the neck and trochanters, also produced at any age by considerable violence, and in which impaction is usually prevented by the free splitting of the lower fragment, though in other cases the fragments may be variously

[redacted]

[redacted] has sufficient vital [redacted] and necrosis of [redacted]

[redacted] presence of lesions of [redacted] wound; and will [redacted] of such injuries [redacted]

[redacted] by the following [redacted] is unable to walk, [redacted] great pain on passive [redacted] as well as the whole [redacted] the length of the limb [redacted]

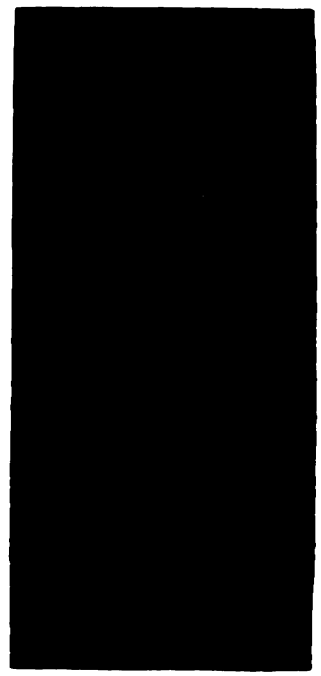


Fig. 164. Fracture of the neck of the thigh-bone. After Sir A. Cooper. The figure represents the advanced age of the patient. The shortening and eversion of the limb, and the sinking in of the trochanter.

[redacted] stretched across the body just [redacted]. On the injured side the [redacted]

The diagnosis between a case of fracture and one of mere *contusion* of the hip is usually easy, all the above characteristic symptoms, except the loss of motion, being absent in the less serious injury.[3] There are cases, indeed, in which the shortening is very slight, and where the eversion consists less in

[1] Brown, 'On the diagnostic value of the ilio-femoral triangle.' 'Proc. of Med. Chir. Soc. vol. v.

[2] 'Syst. of Surg.' 3rd ed. vol. i. p. 163.

[3] It is said, however, that cases of fracture occur in which the fragments remain at first in their natural contact with each other until displaced by the movements of the patient or some accidental cause. If this is true, such a case might (though only for a short time) be mistaken for a mere contusion.

obvious turning out of the foot than in a fixed condition of the limb; where, though the foot does not visibly point outwards, yet it cannot be made to turn inwards, as the other can. Here there is probably fracture high up, with impaction, and the patient may recover very perfectly. An interesting case will be found on p. 133 of Bigelow's work. In some instances it appears that interstitial absorption of the cervix femoris follows after mere contusion,[1] as it undoubtedly does after fracture; and in such cases it would be impossible, some months after the receipt of the injury, to know that no fracture had taken place. From dislocation there is usually no difficulty in the diagnosis. The everted position of the foot and the free mobility of the limb distinguish the ordinary cases from any form of dislocation (compare Fig. 105, with Figs. 133, 135, 139, and 143); while in an impacted fracture with inversion of the foot,[2] simulating at the first glance dislocation on to the dorsum ilii or into the sciatic notch, the absence of the head of the bone from the buttock will distinguish it from the former, and the much greater freedom of passive motion in all directions (especially if the patient be under the influence of chloroform) from the latter dislocation.

There is a very rare form of fracture of the pelvis in which the head of the femur is driven into and more or less completely through the acetabulum.[3] I have seen this injury mistaken for fracture of the cervix femoris, and the mistake is really of very little consequence. But if any doubt existed it might probably be set at rest by examination under chloroform, since the head of the bone is believed to be usually jammed tightly into the pelvis in these cases. But the injury is a very rare one, and little is therefore known as to its symptoms.

Diagnosis of intra- from extra-capsular fracture.

The above account shows that there is not generally any great difficulty in deciding whether the neck of the femur is or is not fractured. It is usually less easy to be sure whether the line of fracture is or is not wholly intra- or wholly extra-capsular; and indeed the great majority of fractures cannot strictly be limited by either term, for the line of fracture, though partly or chiefly below the attachment of the capsule, will be found to pass up into the cavity of the joint. In well-marked instances of either class the following

[1] I have myself seen this shortening from interstitial absorption come on gradually in a case which was carefully examined soon after the injury by myself and other surgeons, who were all satisfied that no fracture existed. See also Wilks and Moxon, 'Path. Anat.,' 2nd ed. p. 56.

[2] Inversion in impacted fracture depends on the usual kind of impaction being reversed. The head of the neck being driven into the tissue at the base of the trochanter major driving the trochanter backwards, the two trochanters are widely separated from each other, and the head wedged in between them, has so pushed forward the trochanter and lower fragment as to turn the whole femur inwards on its own axis. In Bigelow's work and in some papers published by him in the 'Boston Medical and Surgical Journal,' January 1875, the reader will find some interesting speculations on the structure of the neck of the femur and the influence of such structure on the impaction of fracture. The eversion which accompanies the common non-impacted fracture appears to me to be due chiefly to the natural tendency of the foot to fall outwards when the muscular force is removed from the limb. This is constantly observed in sleep and in coma, and after non-impacted fracture of the femur in part. the limb is in a somewhat similar condition in respect to muscular action. I am inclined, however, absolutely to deny that the external rotator muscles may be enabled to get greater advantage on the lower fragment after the fracture of the neck and the shortening which follows it, as Mr. Davies-Colley argues. See this question ably discussed by Mr. Owen, Mr. Spence and Mr. Davies-Colley in the 'Brit. Med. Journ.' Oct. 4, Nov. 1, and Nov. 15, 1879.

[3] See 'Med.-Chir. Trans.' vol. xxxiv. p. 107. There is a specimen in the Museum of St. Thomas's Hospital, Ser. i. No. 123, showing this injury, which was mistaken for fracture of the neck of the thighbone, as mentioned in the text.

rules will apply: 1. Intracapsular fracture is more purely an injury of old age than the extracapsular form. The absorption of the bone from senile atrophy, producing fatty degeneration of its tissues, shortening, and loss of the natural obliquity of the neck of the femur, must render it prone to give way from very slight causes: and thus, in extreme old age, the neck of the thighbone is sometimes broken from the most trifling injuries, even from catching the toe in the carpet or bedclothes. Such fractures are in all probability intracapsular.[1] It is, however, a mistake (though one often committed) to believe that this change in the neck of the thighbone is one which is universal or nearly so in old age, and that therefore most fractures of the cervix in old people are intracapsular. On the contrary, the change in question only occurs in some proportion hitherto, I believe, undetermined of the aged; and the extracapsular is certainly more common in old age than the intracapsular fracture. This latter form, however, is almost exclusively found in the aged. When, therefore, the fracture has occurred from a very slight cause in an old person, we conclude that it is probably intracapsular.

2. If the fracture be not impacted the amount of shortening which immediately follows the injury is usually less after the intra- than the extra-capsular fracture, and there is less crepitus, if the surgeon thinks it desirable to make the manipulation necessary in order to elicit the crepitus. But this, in my opinion, should rarely if ever be done. It puts the patient often to much pain, and may have an injurious effect on the progress of the case, which the object sought to be obtained does not justify.

3. The surest test between an intra- and extra-capsular fracture when it is available (which, however, in the majority of cases it is not), is to note whether the trochanter moves with the lower fragment. If the movement of the lower fragment is not communicated to the trochanter the fracture cannot, of course, be above the intertrochanteric line; but the movement of the trochanter along with the lower fragment does not prove the contrary (i.e. that the fracture is intracapsular), since the fragments may be more or less closely interlocked.

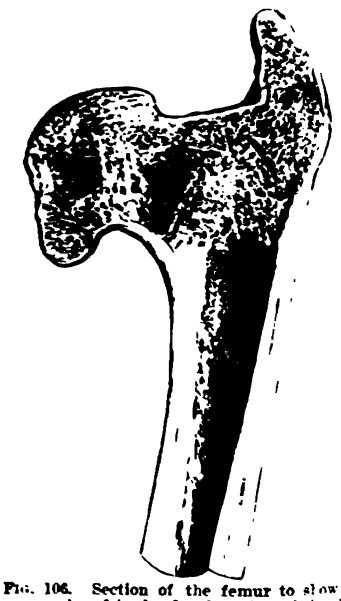


FIG. 106. Section of the femur to show the atrophy of its head and neck, and the alteration in the direction of the latter from the changes. The head is on a lower level than the great trochanter, and the neck runs horizontal instead of an oblique direction. St. George's Hospital Museum, Ser. ii. No. 7.

Such are the characters which seem to me worthy of study when we wish to distinguish these two forms of fracture from each other. I may add that

[1] Fractures of the neck of the femur caused by such trifling injuries can hardly be impacted, but that more powerful sprains may lead to extracapsular fracture which may even be impacted, has been shown by an interesting case published by Dr. Riedinger of Würzburg in the Centralblatt f. Chir. 1875, p. 52. A man of sixty slipping on the snow, tries to save himself and falls on his *left* side. He rises and makes a few steps with very grievous pain and then perceives that his *right* leg is shortened. Examination proves the existence of an extracapsular fracture with slight impaction. The fracture must have occurred in consequence of the neck of the femur being caught between the twisting force of the fall and the resistance of the ilio-femoral ligament. The impaction was probably caused by the attempt to walk.

they become less trustworthy the more completely the fragments are impacted. This impaction happens much more frequently in the extracapsular form, so frequently, indeed, that one great authority—Dr. R. W. Smith—believes that all extracapsular fractures are impacted at the moment of injury, though doubtless the fragments are often detached from each other afterwards.

When the impaction is complete the fragments cannot be moved on each other by any force which the surgeon would employ. Hence the shortening cannot be made to disappear, nor can crepitus be elicited. But in less firm impaction (or perhaps simple interlocking of the fragments) passive motion detaches them, crepitus is produced, and when extension is removed the shortening is found to have become much greater than before.

The *treatment* of fracture of the neck of the thighbone will depend mainly on the age and constitutional condition of the patient. Sir Astley Cooper proved that fracture of the neck of the thighbone within the capsule does not usually unite by bone. In some rare cases it will do so, as shown in the annexed figure; and it is probable that when it does do so the cause is generally impaction of the fractured head in the tissue of the cervix, as was the case in that instance.[1] More commonly the union is ligamentous or there is no union at all, and in the latter case the fractured surfaces are often polished off, and a kind of false joint is found in the interior of the true one. The causes of this defect of union are variously stated. There can be no doubt that the main reason is the impossibility of keeping the ends in contact, and perhaps the frequent slight misplacements to which, under the action of the muscles inserted into the trochanter, the lower fragment is constantly liable. But many other causes have been assigned, viz. the age of the patient, the atrophy of the bone, the percolation of synovial fluid between the fragments, and the small supply of blood to the upper fragment—only from the small branch which runs in the ligamentum teres. The first is a cause about which there can be no doubt; and in the only other very common injury where non-union is the rule, viz. the transverse fracture of the patella, the conditions are similar in respect to the impossibility of proper coaptation of the fragments, though in every other particular they are usually quite different. This, therefore, may safely be regarded as the main reason, though some others may conspire in preventing bony union. This want of bony union exists, however, only in the intracapsular fracture. Extracapsular fractures unite as soundly as any other fracture.

Treatment.



Bony union of intracapsular fracture. From St. George's Hospital Museum, Ser. I. No. 42 a.

The treatment which Sir Astley Cooper recommended consisted merely in supporting the knee on a pillow, keeping the patient in bed until movement was no longer very painful to him—say from a fortnight to three weeks—and then allowing him to get up and move about as much as he could with

[1] Two similar instances of bony union of intracapsular fracture with impaction are recorded and figured by Bigelow, 'On Dislocation and Fracture of the Hip,' pp. 131–135. These are strikingly like that in the text.

overlooked a dislocation. The real fact is, that rest of the sprained joint has been carried on too long. But this fact—though there can be no doubt of it, and everyone must have had frequent opportunities of verifying it—must not lead us into the opposite error of decrying the use of complete rest in sprains, especially in the lower limb; nor into that of insisting on too early passive or active motion, which would reproduce the inflammation and much prolong the mischief. Passive motion, shampooing, &c., should be begun as early as seems prudent, but always gradually and with caution, and at first with prolonged intervals of rest.

Wounds.

Wounds of the lower extremity need not detain us in this place. The injuries of large arteries (as the femoral) have been spoken of above. The wounds of joints, and especially of the knee-joint, are the most striking feature in the regional surgery of such injuries. When the knee-joint is opened by a clean cut the nature of the injury is known by the escape of synovial fluid and by the effusion into the cavity. Unless a foreign body is known to be lodged, no probing or other examination is admissible. Otherwise the cut is to be carefully united, and the joint equably and firmly strapped, the limb being bandaged from the toes upwards, on a well-fitting splint, just as after the operation for removing a loose cartilage. If swelling, pain, and fever should testify to the access of acute inflammation, then the joint must be exposed, leeches very freely applied, and afterwards ice or Leiter's tubes kept on the part constantly. If the case does badly, its further progress resolves itself into the diagnosis and treatment of acute abscess in the joint (for which see the chapter on DISEASES OF THE JOINTS); but if it does well the symptoms gradually subside, and the patient recovers, usually with more or less of ankylosis, though possibly in some cases completely.

Of knee-joint.

Foreign bodies may lodge in wounds, especially of the buttock, and are frequent in the foot; but I can add nothing on this head to what has been said above (p. 231).

Fracture of cervix femoris.

Fracture of the neck of the femur—a common accident in old persons of both sexes—takes place entirely within the capsular ligament of the hip-joint, or else partly or wholly external to that cavity. The former fractures are called *intracapsular*, the latter *extracapsular*.

The annexed figures will show the usual forms of fracture of the neck of the femur. The division into extra- and intra-capsular—which was made by Sir A. Cooper, and which is ordinarily followed in our schools—appears to me one of considerable importance; but another of equal, and, according to the judgment of some writers of great authority, of even greater practical value, is into the impacted and the non-impacted fractures. The series is not, of course, intended to exhibit all the varieties which are met with, but it does show those which are most clearly distinguishable from each other, and the characters of which it is important to bear in mind.

Fig. 101 is the truly intracapsular fracture which generally occurs in old age, and often from slight causes; it is usually free from impaction, and rarely found united by bone.

This fracture, however, may be impacted, and in such cases, at any rate, bony union does occur. This is shown by Fig. 107.

Fig. 102 shows the ordinary impacted extracapsular fracture which occurs both in old age and at earlier periods, in which the upper fragment (comprising the head and the whole of the neck) is driven into the cancellous

tissue of the base of the trochanter, and firmly wedged there; so that in the case from which the preparation was taken, and where the same fracture had occurred on both sides, at four years' interval, in the recent fracture the upper



FIG. 101. The common, non-impacted, intracapsular fracture of the neck of the thigh-bone.—From a preparation in St. George's Hospital Museum, Ser. i. No. 180.



FIG. 102. The common, impacted, extracapsular fracture of the cervix femoris. From a woman aged seventy-four at the time of her death, who had had fracture on one side four years, on the other five weeks, before her death, both injuries being almost exactly similar. The old injury was completely united by bone; the recent one, here shown, was firmly impacted, but the fragments separated in maceration.—St. George's Hospital Museum, Ser. i. No. 207.

fragment was so firmly wedged into the lower that it was only separated by maceration. This fracture unites always by bone.

Fig. 103, on the other hand, represents the common form of comminuted



FIG. 103. The common, comminuted non-impacted fracture of the neck and trochanters.—From a specimen (Ser. i. No. 142 b) in the Museum of St. George's Hospital.



FIG. 104. A gunshot wound, causing intracapsular fracture of the neck of the femur, in a young man (aged 25). A charge of small-shot passed through the hip-joint, from a very short distance, at the back of the limb ('balled,' according to the common expression), cleanly dividing the femur. It will be noticed that the back part of the bone is notched by the shot in two or three places.—From a specimen in St. George's Hospital Museum, Ser. i. No. 136.

fracture of the neck and trochanters, also produced at any age by considerable violence, and in which impaction is usually prevented by the free splitting of the lower fragment, though in other cases the fragments may be variously

impacted or interlocked. Union will occur if the patient has sufficient vital power, and if not interfered with by inflammation, abscess, and necrosis of detached fragments.

Fig. 104 is introduced to illustrate the occasional occurrence of lesions of the neck of the femur at earlier ages, in this case from direct wound; and will also be hereafter referred to in connexion with the treatment of such injuries when compound.

Symptoms and diagnosis of fracture of cervix femoris.

The neck of the femur may be known to be fractured by the following signs. After an injury, of more or less severity, the patient is unable to walk, or even in most cases to move the limb, complains of great pain on passive motion, the affected limb is shorter than the other, the foot, as well as the whole limb, is everted in most cases. If no impaction exists, the length of the limb may be restored by traction, and crepitus will then easily be obtained. On rotating the limb the trochanter is observed to move through a smaller arc. If the fracture is impacted the trochanter moves along with the head of the bone, and in a circle of which the head is the centre. The position of the trochanter major is a matter of much importance in fractures of the neck of the thigh-bone. In the ordinary non-impacted fracture, shown in Sir A. Cooper's figure, the trochanter is sunk as well as displaced upwards. In the rarer cases of impacted fracture with inversion it is of course prominent, but in all cases it is nearer to the pelvis than natural. This displacement can be verified either by 'Nélaton's test' of stretching a string from the anterior superior spine to the tuber ischii—which in the natural condition only just touches the top of the trochanter, or lies wholly above it—or by Mr. Bryant's method of measuring the vertical distance between the top of either trochanter and a horizontal line which touches both the anterior superior spines,[1] or by Mr. Morris's of measuring the distance of a perpendicular drawn through the outside of the great trochanter on the two sides from the centre of a rod or string stretched across the body just above the pubes (bi-trochanteric measurement). On the injured side the distance is always less.[2]

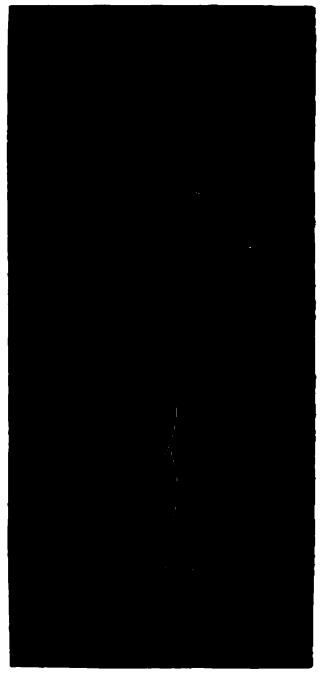


Fig. 105. Fracture of the neck of the thigh-bone. After Sir. A. Cooper. The figure shows the advanced age of the patient, the shortening and eversion of the limb, and the falling in of the trochanter.

The diagnosis between a case of fracture and one of mere *contusion* of the hip is usually easy, all the above characteristic symptoms, except the loss of motion, being absent in the less serious injury.[3] There are cases, indeed, in which the shortening is very slight, and where the eversion consists less in

[1] Bryant, 'On the diagnostic value of the ilio-femoral triangle.' 'Proc. of Med. Chir. Soc.' vol. vii.

[2] 'Syst. of Surg.' 3rd ed. vol. i. p. 1003.

[3] It is said, however, that cases of fracture occur in which the fragments remain at first in their natural contact with each other until displaced by the movements of the patient or some accidental cause. If this is true, such a case might (though only for a short time) be mistaken for a mere contusion.

obvious turning out of the foot than in a fixed condition of the limb; where, though the foot does not visibly point outwards, yet it cannot be made to turn inwards, as the other can. Here there is probably fracture high up, with impaction, and the patient may recover very perfectly. An interesting case will be found on p. 133 of Bigelow's work. In some instances it appears that interstitial absorption of the cervix femoris follows after mere contusion,[1] as it undoubtedly does after fracture; and in such cases it would be impossible, some months after the receipt of the injury, to know that no fracture had taken place. From dislocation there is usually no difficulty in the diagnosis. The everted position of the foot and the free mobility of the limb distinguish the ordinary cases from any form of dislocation (compare Fig. 105, with Figs. 133, 135, 139, and 143); while in an impacted fracture with inversion of the foot,[2] simulating at the first glance dislocation on to the dorsum ilii or into the sciatic notch, the absence of the head of the bone from the buttock will distinguish it from the former, and the much greater freedom of passive motion in all directions (especially if the patient be under the influence of chloroform) from the latter dislocation.

There is a very rare form of fracture of the pelvis in which the head of the femur is driven into and more or less completely through the acetabulum.[3] I have seen this injury mistaken for fracture of the cervix femoris, and the mistake is really of very little consequence. But if any doubt existed it might probably be set at rest by examination under chloroform, since the head of the bone is believed to be usually jammed tightly into the pelvis in these cases. But the injury is a very rare one, and little is therefore known as to its symptoms.

Diagnosis of intra- from extra-capsular fracture.

The above account shows that there is not generally any great difficulty in deciding whether the neck of the femur is or is not fractured. It is usually less easy to be sure whether the line of fracture is or is not wholly intra- or wholly extra-capsular; and indeed the great majority of fractures cannot strictly be limited by either term, for the line of fracture, though partly or chiefly below the attachment of the capsule, will be found to pass up into the cavity of the joint. In well-marked instances of either class the following

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[2] Inversion in impacted fracture depends on the usual kind of impaction being reversed. Instead of the neck being driven into the tissue at the base of the trochanter major driving the trochanter backwards, the two trochanters are widely separated from each other, and the head, wedged in between them, has so pushed forward the trochanter and lower fragment as to turn the whole femur inwards on its own axis. In Bigelow's work and in some papers published by him in the 'Boston Medical and Surgical Journal,' January 1875, the reader will find some interesting speculations on the structure of the neck of the femur and the effect of such structure on the impaction of fracture. The eversion which accompanies the common non-impacted fracture appears to me to be due chiefly to the natural tendency of the foot to fall outwards when the muscular force is removed from the limb. This is constantly observed in sleep and in coma, and after non-impacted fracture of the femur in any part, the limb is in a somewhat similar condition in respect to muscular action. I am inclined, however, absolutely to deny that the external rotator muscles may be enabled to act at greater advantage on the lower fragment after the fracture of the neck and the shortening which follows it, as Mr. Davies-Colley argues. See this question ably discussed by Mr. Owen, Mr. Spence and Mr. Davies-Colley in the 'Brit. Med. Journ.' Oct. 4, Nov. 1, and Nov. 15, 1879.

[3] See 'Med.-Chir. Trans.' vol. xxxiv. p. 107. There is a specimen in the Museum of St. George's Hospital, Ser. i. No. 123, showing this injury, which was mistaken for fracture of the neck of the thighbone, as mentioned in the text.

rules will apply: 1. Intracapsular fracture is more purely an injury of old age than the extracapsular form. The absorption of the bone from senile atrophy, producing fatty degeneration of its tissues, shortening, and loss of the natural obliquity of the neck of the femur, must render it prone to give way from very slight causes; and thus, in extreme old age, the neck of the thighbone is sometimes broken from the most trifling injuries, even from catching the toe in the carpet or bedclothes. Such fractures are in all probability intracapsular.[1] It is, however, a mistake (though one often committed) to believe that this change in the neck of the thighbone is one which is universal or nearly so in old age, and that therefore most fractures of the cervix in old people are intracapsular. On the contrary, the change in question only occurs in some proportion (hitherto, I believe, undetermined) of the aged; and the extracapsular is certainly more common in old age than the intracapsular fracture. This latter form, however, is almost exclusively found in the aged. When, therefore, the fracture has occurred from a very slight cause in an old person, we conclude that it is probably intracapsular.



Fig. 106. Section of the femur to show the atrophy of its head and neck, and the alteration in the direction of the latter from senile changes. The head is on a lower level than the great trochanter, and the neck has a horizontal instead of an oblique direction.—St. George's Hospital Museum, Ser. ii. No. 7.

2. If the fracture be not impacted the amount of shortening which immediately follows the injury is usually less after the intra- than the extra-capsular fracture, and there is less crepitus, if the surgeon thinks it desirable to make the manipulation necessary in order to elicit the crepitus. But this, in my opinion, should rarely if ever be done. It puts the patient often to much pain, and may have an injurious effect on the progress of the case, which the object sought to be obtained does not justify.

3. The surest test between an intra- and extra-capsular fracture when it is available (which, however, in the majority of cases it is not), is to note whether the trochanter moves with the lower fragment. If the movement of the lower fragment is not communicated to the trochanter the fracture cannot, of course, be above the intertrochanteric line; but the movement of the trochanter along with the lower fragment does not prove the contrary (i.e. that the fracture is intracapsular), since the fragments may be more or less closely interlocked.

Such are the characters which seem to me worthy of study when we wish to distinguish these two forms of fracture from each other. I may add that

[1] Fractures of the neck of the femur caused by such trifling injuries can hardly be impacted, but that more powerful sprains may lead to extracapsular fracture which may even be impacted, has been shown by an interesting case published by Dr. Riedinger of Würzburg in the Centralblatt f. Chir. 1875, p. 52. A man of sixty slipping on the snow, tries to save himself and falls on his *left* side. He rises and makes a few steps with very grievous pain, and then perceives that his *right* leg is shortened. Examination proves the existence of an extracapsular fracture with slight impaction. The fracture must have occurred in consequence of the neck of the femur being caught between the twisting force of the fall and the resistance of the ilio-femoral ligament. The impaction was probably caused by the attempt to walk.

they become less trustworthy the more completely the fragments are impacted. This impaction happens much more frequently in the extracapsular form, so frequently, indeed, that one great authority—Dr. R. W. Smith—believes that all extracapsular fractures are impacted at the moment of injury, though doubtless the fragments are often detached from each other afterwards.

When the impaction is complete the fragments cannot be moved on each other by any force which the surgeon would employ. Hence the shortening cannot be made to disappear, nor can crepitus be elicited. But in less firm impaction (or perhaps simple interlocking of the fragments) passive motion detaches them, crepitus is produced, and when extension is removed the shortening is found to have become much greater than before.

The *treatment* of fracture of the neck of the thighbone will depend mainly on the age and constitutional condition of the patient. Sir Astley Cooper proved that fracture of the neck of the thighbone within the capsule does not usually unite by bone. In some rare cases it will do so, as shown in the annexed figure; and it is probable that when it does do so the cause is generally impaction of the fractured head in the tissue of the cervix, as was the case in that instance.[1] More commonly the union is ligamentous or there is no union at all, and in the latter case the fractured surfaces are often polished off, and a kind of false joint is found in the interior of the true one. The causes of this defect of union are variously stated. There can be no doubt that the main reason is the impossibility of keeping the ends in contact, and perhaps the frequent slight misplacements to which, under the action of the muscles inserted into the trochanter, the lower fragment is constantly liable. But many other causes have been assigned, viz. the age of the patient, the atrophy of the bone, the percolation of synovial fluid between the fragments, and the small supply of blood to the upper fragment—only from the small branch which runs in the ligamentum teres. The first is a cause about which there can be no doubt; and in the only other very common injury where non-union is the rule, viz. the transverse fracture of the patella, the conditions are similar in respect to the impossibility of proper coaptation of the fragments, though in every other particular they are usually quite different. This, therefore, may safely be regarded as the main reason, though some others may conspire in preventing bony union. This want of bony union exists, however, only in the intracapsular fracture. Extracapsular fractures unite as soundly as any other fracture.

Treatment.



Fig. 57. Bony union of intracapsular fracture. —From St. George's Hospital Museum, Ser. i. No. 42 a.

The treatment which Sir Astley Cooper recommended consisted merely in supporting the knee on a pillow, keeping the patient in bed until movement was no longer very painful to him—say from a fortnight to three weeks—and then allowing him to get up and move about as much as he could with

[1] Two similar instances of bony union of intracapsular fracture with impaction are described and figured by Bigelow, 'On Dislocation and Fracture of the Hip,' pp. 131–135. The figures are strikingly like that in the text.

ease. The result of this would, of course, be the non-union of the fracture; but this was a matter of minor importance in Sir A. Cooper's view, since he laid so much stress on the fact that intracapsular fractures do not as a rule unite by bone. And there can be no doubt that if attempts are too much persisted in to procure consolidation of the fracture by rigid confinement during many weeks, the patient (being an old person) is almost sure to suffer from sloughing produced by the splints, or from bedsores, and will very likely die. In such patients therefore the treatment above described, or something like it, is the best. But this does not apply to fractures of the neck of the thighbone in younger and more vigorous people. In them the fracture is either impacted or non-impacted. If the former, no attempt should be made to disengage the fragments, since it cannot be done without an amount of violence which would be highly dangerous, and which is quite unjustifiable. Such impacted fractures require only rest for their consolidation. The limb is steadied by the application of a weight to the foot, along with a case of splints lightly applied to the thigh, or by the long splint, for about six weeks, when it can be put up in a starched pasteboard, or a Hides's felt splint. Comminuted and other non-impacted fractures in patients tolerably vigorous

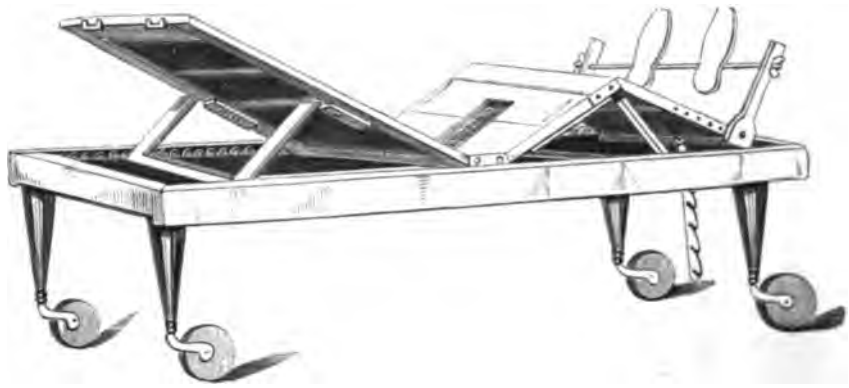


FIG. 108. Earle's bed, or the double-inclined plane for the treatment of fracture of the upper part of the femur. Extension is made by fixing the foot, or feet, to the movable footpieces at the bottom of the bed. Counter-extension is made by the weight of the body gravitating down to the bottom of the bed, in which there is an opening for the passage of the dejecta.

and not too old are to be treated with the long splint, just like any other fracture of the thigh. Some surgeons prefer Earle's bed in these cases, and it is certainly less exposed to the risk of producing ulceration or sloughing of the skin, although it makes far less efficient extension than the long splint.

Other fractures of the upper end of the bone.

Some alleged cases of disjunction of the upper epiphysis of the femur are recorded;[1] but they do not seem to me conclusive as to the real existence of this lesion as a substantive injury.

Fracture of the trochanter major, without any solution of continuity of the shaft or neck, has been known to occur both before and after the junction of its epiphysis. One in an old man is recorded and figured by Sir A. Cooper,[2] and in a girl of sixteen by the same author, on the authority of Mr. Aston Key. It was caused by direct violence. The symptoms given are pain at the part, and particularly on passive motion, eversion of the foot, deformity of the

[1] 'Syst. of Surg.' 3rd ed. vol. i. p. 1008.

[2] 'On Fractures and Dislocations,' 2nd ed. pp. 158, 171. The dissection of an old specimen of this injury is well described by Dr. Warren, 'Dublin Journ. Med. Sci.' July 1876.

trochanter, and crepitus, without shortening of the limb. The injury is to be treated in the same way as fracture of the cervix. The fracture unites well, and the limb will very probably be perfectly useful.

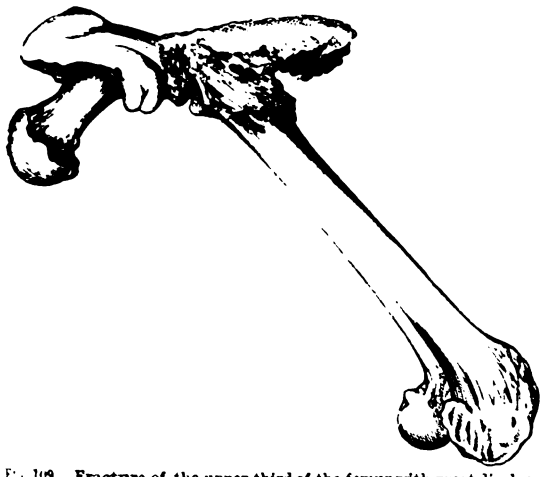


Fig. 109. Fracture of the upper third of the femur with great displacement. From Sir A. Cooper's work on 'Fractures and Dislocations' (pl. xii. fig. 6), thus described by him: 'The thighbone fractured below the trochanter minor, and drawn into a most deformed union by the action of the psoas and iliacus internus muscles.'

Fracture of the body of the femur is a very common accident, and it generally occurs in the middle of the bone, at a variable level. The cause is usually indirect violence, i.e. a fall or strain, by which the bone is bent and snaps; in rarer cases it breaks in consequence of a direct blow upon the thigh. There is rarely any difficulty in recognising the nature of the injury, as the lower part of the limb is freely movable. Exceptional cases, in which impaction causes some amount of difficulty, will be recognised by the alteration in the length and in the axis of the limb.



Fig. 110. Oblique fracture of the femur, just below the trochanter minor, most irregularly consolidated. The upper fragment appears to have resumed its normal position, but the lower one crosses the front of the upper fragment obliquely from within outwards, and is firmly united to it by a bridge of new bone passing from the fractured end of the upper fragment to the surface of the lower fragment below the fracture. The medullary canal of the upper fragment was filled up by bone at the seat of injury, but in the lower fragment it is pervious. The head of the femur presents several irregular projections of bone, one of which, close to the attachment of the ligamentum teres, is of a curious hook-like form, and fitted into a similar depression in the acetabulum. The cartilages of the hip-joint were almost destroyed, but there was no pus in the joint nor any adhesions. The preparation was found in examining the body of a man aged seventy-six, who died of disease of the kidneys and bladder.

Three forms of fracture of the femur are described, viz. fracture of the upper third, of the body, and of the lower end.

Fracture of the upper third of the femur.

Fracture of the upper third of the femur is a formidable injury. In the words of Sir A. Cooper,[1] 'it is a difficult accident to manage, and miserable distortion is the consequence if it be ill-treated.' The distortion to which Sir Astley refers is that shown in Fig. 109, copied from his work, showing the upper fragment tilted forwards and outwards, and the lower fragment lying under it, irregularly united to it by a bridge of bone, the axes of the two fragments forming a great angle. But this distortion is not the one which is always found in these cases. Fig. 110, from the Museum of St. George's Hospital, shows an equally 'miserable distortion,' but in the opposite direction, since here the upper fragment remains in its natural position, while the lower

[1] See the section 'On Fractures below the Trochanter,' in Sir A. Cooper's work, 'On Dislocations and on Fractures of the Joints.'

fragment is driven across the front instead of the back part of the upper, and points upwards and outwards. In both cases the foot must have been far from the ground, and the patient could only have walked with great slowness and difficulty. Sir A. Cooper refers the distortion to the action of the psoas and iliacus, and to that only; but the explanation is evidently imperfect. Allowing that these muscles may exercise traction on the upper fragment, it is evident that they cannot abduct it as well as flex it (as is seen in Fig. 111), and this part of the displacement in this and cases similar to this is now ascribed by most surgeons to the pressure of the lower fragment, which often drives the bone upwards, though others believe that the action of the abductor muscles is also called into play. The shortening is often caused really more by the abduction and the consequent angular deformity than by the riding or anterior displacement (Fig. 112). Evidently the position of the lower frag-



FIG. 111. Fracture of the femur immediately below the trochanters, seen on the anterior aspect. The lower fragment has passed immediately behind the upper, and the latter is driven into a position of extreme abduction, so that the head is inclined considerably inwards and forwards. An enormous callus enveloped the two fragments behind, and in this anterior view a broad and long osseous stalactite is seen leaning against the lower part of the head of the femur, as if giving it support. It is remarkable that the upper fragment, though in front of the lower, is not flexed in the slightest degree. On the contrary, one might say that it had been directed a little backwards, as if to meet the lower fragment. The shortening, due to the riding of the fracture, seems to have measured about an inch.—From Malgaigne's 'Atlas,' pl. xiii. fig. 1.



FIG. 112. Fracture about two inches below the small trochanter. The upper fragment is directed considerably outwards; its anterior projection does not measure more than one-third of an inch, and this is all the shortening that is due to the riding of one fragment on the other, while the shortening due to the angular deformity is more than an inch. From Malgaigne, pl. xiii. fig. 2.

ment is the point to which the greatest attention should be directed, both in the reduction and in the after-treatment. The great point, as it seems to me, is to disengage this fragment, in whatever position it may be lying, to draw it down and to place it in the axis of the limb, for which purpose it is desirable to put the patient under chloroform; and it may be justifiable in extreme cases even to apply the pulleys. When the fracture has thus been completely reduced I have never seen any evil consequence, nor any difficulty in treating it by means of the long splint, which is far more trustworthy than any other apparatus in this fracture. I have never seen cases successfully treated by the double-inclined plane (Earle's bed), recommended by Sir A. Cooper; in fact, it appears to me to exercise no influence whatever on the progress of the case, and to be very insufficient as a safeguard against the reproduction of the

displacement, which is the real danger. If, however, the surgeon is so under the influence of a venerable authority as to fear the action of the psoas in displacing the upper fragment, he can adopt Mr. Busk's thigh-splint, in which there is a joint at the hip, so that the body can be flexed while the long splint steadies the lower fragment.

Fracture in the middle of the bone.

In fractures of the body of the bone the lower fragment generally lies behind and above the upper, either to its inner or outer side. Fig. 113 and Fig. 31 (p. 119) illustrate varieties in the displacement of this fracture, but it is certainly almost constant for the upper fragment to be in front of the lower; the foot also is always everted or rotated outwards, unless in some rare cases the fragments should be so interlocked that it is driven inwards. The main cause of both displacements seems to be the weight of the lower part of the limb. It is not impossible that the psoas and iliacus may raise the lower end of the upper fragment, and that the hamstring muscles may draw the lower backwards, and this explanation is accepted by many authors; but it seems to me that when the support of the skeleton is withdrawn by snapping the femur the leg naturally falls backwards and the foot outwards. At any rate, if muscular action has anything to do with the displacement it does not usually affect the treatment to any recognisable extent. This treatment consists first in the careful setting of the fracture, and in doing this the surgeon should not grudge the time necessary to verify its accuracy. He should ascertain by the most exact measurement that the length of the fractured thigh is the same as the other, and, by careful comparison of the various points of the two limbs, that there is no angular or rotatory displacement. The treatment which is usually adopted at St. George's and I believe at all the other London hospitals, is that by the long splint—whether Desault's or Liston's makes little matter—assisted by short splints, encasing the thigh, and preventing any minor displacements of the fragments on each other (Figs. 114, 115). These latter, perhaps, are not absolutely necessary, and some surgeons only use the short splints to correct any deformity which is obvious. If short splints are not used, it is an old and, I believe, good practice to bandage the limb evenly and carefully up to the seat of fracture, and some surgeons carry the bandage up the whole limb.



Fig. 113. An old, badly-set, fracture of the femur, united by a large bridge of bone, which covers over the medullary canal of both fragments. The upper fragment projects on the outer side of the lower, and is directed from above outwards and forwards, while the lower is displaced considerably upwards, and points from below also, backwards and outwards. Compare this with Fig. 31, p. 119.

There are many other methods of treatment, of which I cannot profess much personal experience; for though I have occasionally tried some of them, I have not found any reason for thinking that they are superior to the above in the ordinary fractures of adults, while they unquestionably involve some risk, and are not so easy of application. Thus, the American surgeons are fond of

applying the constant extending force of a weight passing over a pulley at the bottom of the bed, counter-extension being applied by fixing a perinæal band to the head of the bed, so that the patient cannot get down below a certain level in it. The weight is in some cases supplemented by short splints applied between the knee and the groin. The amount of weight must be regulated by the size of the limb. For an adult probably ten or twelve pounds would be about the average (Fig. 116).

Other plans contemplate a combination of the steadiness of the long splint with the permanent extension produced by the weight, substituting for the latter a spring or indiarubber band or accumulator inserted into a jointed

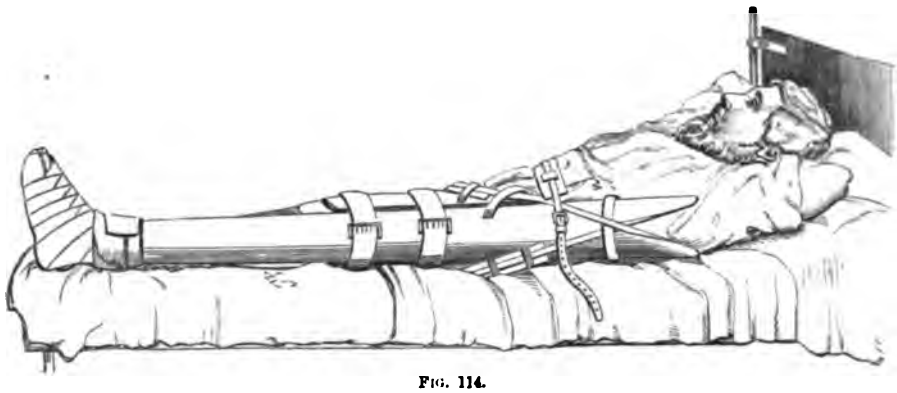


FIG. 114.

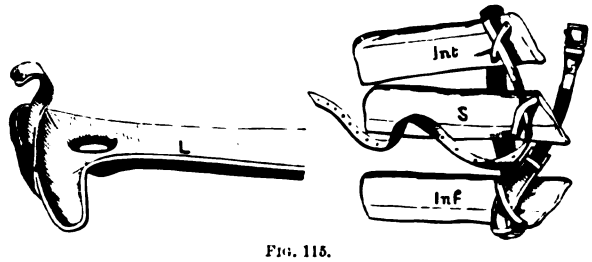


FIG. 115.

FIGS. 114 and 115. A fracture of the thigh put up with Desault's long splint and short thigh-splints. Fig. 114 shows the general features of the apparatus. The long splint extends from the foot to the axilla. Desault's splint is provided with a foot-piece, as shown in Fig. 115. Liston's splint, which is in more constant use, though I think inferior to Desault's, ends in a notched extremity, extending several inches below the foot. The object is to correct the tendency to eversion of the foot by the traction exercised on it by the bandage passing through the notch. The objection to it is that, in the words of a late house-surgeon at one of the hospitals where it is in use, 'it is apt to strain the ankle-joint, and sores are likely to form about the malleoli, and over the tendo Achillis' ('Lancet,' Oct. 10, 1874, p. 512). The short splints are strung on the perinæal band, as shown in Fig. 115. They are secured by a couple of webbing straps, and the long splint is kept in position by a bellyband. The perinæal band is passed through the notch, then around the splint from below upwards, and finally out of the notch again, being buckled outside the splints. This buckle has been accidentally omitted in Fig. 114.

splint. Such is the splint invented by Mr. Cripps, in which the foot is drawn down and kept down by a constant elastic force, and of which Mr. Bryant speaks in high terms; and other similar apparatus have been invented by Mr. De Morgan and other surgeons, but I have not sufficient experience of them to have formed any opinion of their real practical value as compared with the usual plan of treatment.[1]

Many surgeons adopt the plan of putting up the fractured thigh at once, or very soon after the accident, in an immovable apparatus, such as a starched bandage, a plaster-of-Paris splint, or a leather collar.

[1] The latest of these plans of making constant extension will be found described by Mr. C. B. Browne, from Mr. Erichsen's hospital practice in the 'Lancet,' October 10, 1874.

In America the limb is sometimes slung by means of a bent rod adapted to the front of the foot, leg, and thigh, the knee-joint being slightly bent. Hooks are inserted into the back of the rod, so as to sling it from a pulley over the bed. The fracture is carefully set, and the rod then securely bandaged on to the limb. The constant traction of the weight of the leg and foot is supposed to counteract any tendency to shortening. But the plan should only be employed (if at all) when a wound on the front or side of the limb prevents the use of the ordinary splints. Even in such cases it would be better, in my opinion, to put up the limb in plaster of Paris, cutting a hole for the wound.

Now, if we wish to form an estimate of the relative value of these new plans, we have, in the first place, to inquire what has been the result of the old treatment—that by the long splint. I think we may take it as established, by consent of all the best writers, that in ordinary cases of fractured femur in the adult with displacement, the result of treatment by the long splint is, as a rule, to leave a certain amount of shortening. Malgaigne, in fact, goes so far as to say: 'When the fragments remain in contact, or when we can replace them, and keep them so by means of their serrations, it is easy to cure a fracture of the femur without shortening; in the absence of these two conditions

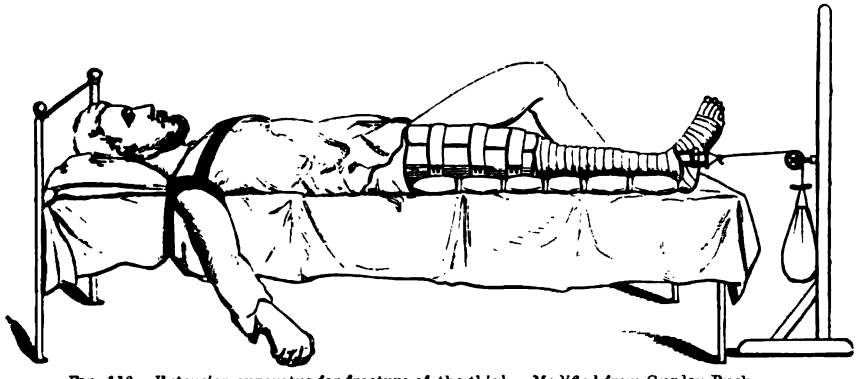


Fig. 116. Extension apparatus for fracture of the thigh. Modified from Gurdon Buck. 'New York Medical Record.'

the thing is simply impossible' (Packard's 'Malgaigne,' p. 581). Without going quite so far as this, I think we may say that everyone who has examined limbs treated with the utmost care by our best surgeons with the long splint agrees that if they are measured with perfect accuracy a shortening of at least half an inch is ordinarily found in the adult, but that in children recovery without shortening very often takes place, and is probably the rule. In children, however, the first of Malgaigne's conditions is generally present, i.e. the fragments have never quitted each other, but remain in contact, so that as soon as the limb is straightened it is found to be the same length as the other. By those who advocate the use of permanent extension, either by the weight or elastic springs, this defect is attributed to the indisputable fact that the long splint can make no active extension, and that the bandages by which it is fixed must relax to such an extent as to prevent the extension made at the moment of 'setting' from being accurately maintained. But it must be admitted that up to the present time we have obtained no reliable evidence that the treatment by permanent extension gives any better results, and it may also be said that in fact the results of the long splint, though not mathematically perfect, are usually good enough for all practical purposes; for

though a slight amount of shortening may in almost all cases be detected by measurement, its amount in careful hands is not generally so great as to be perceptible to the patient, since it is corrected by a slight involuntary inclination of the pelvis, and he walks without limping.[1] It is in the more formidable cases, in which the fractured ends have been greatly displaced, or where the fracture is double or comminuted, that the shortening becomes really a deformity, and it is yet to be proved that in such cases permanent extension could be so applied as to remedy this displacement, or that if applied it could be tolerated by the patient; for it must be remembered that permanent extension is much more likely to produce ulceration of the skin than the ordinary method, and affords, as it seems to me, much less security against angular deformity. At the same time I have often used extension by means of a weight as an adjunct to the ordinary treatment, and I think with manifest advantage, when there is much displacement in comminuted and oblique fractures.

The method of putting up fractures of the thigh at once is very applicable in the case of infants and young children. In them the long splint is not well borne, and the bandages are constantly soiled with urine and fæces, and require renewal. A starch or gum bandage, or, better still, the leather collar here figured, will keep the limb straight, which generally is all that is wanted, and the child may be nursed, if in arms. The collar is better than the immovable apparatus, since it can be changed when necessary.

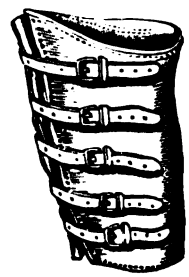


FIG. 117. Leather collar for the treatment of fracture of the (right) femur in a child. The upper part of the collar is covered with oiled silk, to prevent its becoming soiled with urine or fæces.

Some surgeons are in favour of treating fractured thigh in young children without any apparatus at all,[2] merely laying the limb in the abducted position flat on the bed. I have treated some cases successfully in this way, but it seems to be exposed to the risk of angular deformity, as evidenced by the preparation represented in Fig. 118; and as all such risks are obviated by the simple plan above described, I cannot see what motive there is for running any such risk, or for the vertical extension of the limb, which Mr. Bryant recommends.[3] If the surgeon wishes it, a weight can be hung to the child's foot, at the same time as the collar is applied, but I see no necessity for it.

In the adult a fracture of the femur appears to be sufficiently consolidated to bear the weight of the body without danger in nine or ten weeks. Twelve weeks is the usual period during which treatment is continued. Six weeks or more are to be passed in bed, after which, if on examination the union seems firm enough, the immovable apparatus is to be applied, and the patient allowed

[1] It is even possible that the limbs may naturally be of unequal length. A series of sixty measurements undertaken by Dr. Wight of New York (Arch. of Clin. Surg. vol. i. p. 283), on males who had had no known injury, convinced him that only one person out of every five has the two limbs of exactly equal length. I may, however, observe that the difference in all but two of Dr. Wight's cases was under half an inch, and that such difference is not more than a trifling error in measurement would account for. Dr. Wight's results are, however, supported by those of a previous investigator.

[2] See a paper by Mr. Bloxam, 'Respecting the Treatment of Fractures of the Lower Extremities in the Wards under the care of Mr. Paget,' 'St. Bartholomew's Hospital Reports,' vol. ii.

[3] Lib. cit. vol. ii. p. 405.

to move about on crutches for the remainder of the period. When the immovable apparatus is used from the first the patient is spared this confinement to bed; so that Mr. Erichsen, who is the main advocate for its use, says that he scarcely ever finds it necessary to keep patients with simple fracture of the thigh in bed for more than six or seven days. Most surgeons, however, think that the tedium of the confinement to bed is over-balanced by greater safety, and therefore employ some apparatus by which the seat of fracture is exposed: and this involves the necessity of keeping the patient in bed.

In the child under twelve, the period of union and of treatment may be reckoned as about half that of the adult.



Fig. 118. Fracture of the femur in an infant fourteen months old, which had been treated without splints. The child died of measles thirty-two days after the accident. The bone is seen to be much bent at the seat of fracture. This malposition was observed and could easily have been remedied before death, had the child's condition admitted of any interference. In another case similarly treated the bone also bent, but was easily straightened, and the cure completed by means of a leather collar. In two other cases the fracture healed well, and without observed shortening.—From Holmes's 'Sur. Dis. of Childhood.'

Double fractures and comminuted fractures are more difficult to deal with, and require more care in their reduction and treatment, than simple single fractures. In such cases it seems to me undeniable that the treatment by the long splint is much superior to that by permanent extension alone. Compound fracture of the femur is a very grave accident—the danger increasing with age. It is the result usually of gunshot, or of very severe falls, in which the end of the bone is thrust through the muscles and the skin. The first question is, whether to save the limb or amputate. This being settled, on the indications described at p. 116, the limb must be put up in the same way as in

simple fracture, only that, if a long splint be used, it must be bracketed, if necessary, at the situation of the wound, which is hardly ever at the posterior aspect of the limb. The surgeon should be vigilant to detect and give exit to matter as soon as it is formed.

Longitudinal and spiral fractures.

Mr. Morris (op. cit. p. 1021) calls attention to the occurrence of longitudinal and spiral fractures of the femur from torsion of the limb, a form of injury which has been chiefly described by French surgeons—Gerdy, Gosselin, and recently Féré. The latter author believes that he has verified the direction which the line of fracture will take according as the torsion is inwards or outwards; but more extended experience is needed on this head. I have seen this form of injury, producing a long line of fracture with some displacement and much effusion into the knee-joint, together with great increase in the breadth of the femur and much swelling of the whole limb. There may be a good



FIG. 119. Partial separation of the lower epiphysis of the femur. The part of the epiphysis which forms the inner condyle is detached from the shaft by a fracture traversing the epiphysial line. The fracture then bifurcates—one line running down into the lower surface (inter-condyloid notch of the femur), the other somewhat upward, detaching the outer condyle and adjacent portion of the shaft from the rest of the bone.—From the Museum of St. George's Hospital.



FIG. 120. Another case of separation of the lower epiphysis of the femur complicated with fracture. The line of fracture, after running for about half the thickness of the bone in the line of junction of the epiphysis, then turns upwards into the shaft, leaving a large portion of the latter adhering to the outer condyle.—From the Museum of St. George's Hospital.—See Holmes's 'Surg. Dis. of Childhood.'

deal of shortening. Union appears to be slow, and the limb is long useless and painful. The drawings in Mr. Morris's work above referred to give a good idea of the course of these fractures and of the deformity which they may produce.

Fractures of lower end.

Fractures of the lower end of the femur are very common. Long fissures run down into the knee-joint from a considerable distance; but the communication with the joint is often a matter only of conjecture, and they heal frequently, as I believe, without any loss of motion in the joint. More frequently the lower end of the femur is separated from the shaft, by a fracture running transversely above the condyles, and often passing vertically down between them into the joint; and in youth (i.e. below the age of nineteen or twenty) the fracture often passes more or less entirely through the line of junction of the epiphysis, constituting what is called a separation of the epiphysis. I

have shown elsewhere that these separations of the epiphysis are usually complicated with more or less of fracture of the shaft or of the bony epiphysis itself (see page 114), and this is illustrated by the two figures annexed, in one of which the line of fracture runs up into the shaft, and in the other also separates the two condyles from each other. Still there are a few preparations in our museums in which the separation is confined to the epipyhsial line. The differential diagnosis of separation of the epiphysis from fracture must be generally conjectural only, resting on the patient's age. It is conceivable that in a pure disjunction of the epiphysis the surgeon might succeed in absolutely diagnosing the injury, by the absence of bony crepitus, together with the mobility of the fragment; but I am not aware that any such case has occurred. The only importance of the diagnosis would be that, if the surgeon could



FIG. 121. Fracture of the femur above the condyles. The seat of fracture is more than 3 inches above the lower end of the bone. The lower fragment is drawn behind the upper and displaced upwards as much as 1½ inch, the antero-posterior diameter of the femur at this part being more than doubled. The callus is formed by two large bridges of bone, between which there is a large tunnel, closed below. The medullary canal of the lower fragment is seen to be patent, and in the specimen the same is found to be the case in the upper fragment also.—From Malgaigne's 'Atlas,' pl. xv. No. 1.



FIG. 122. Fracture of the femur just above the condyles. The fracture runs obliquely downwards, outwards, and a little forwards. The upper fragment, displaced in this direction, has pushed the patella downwards on to the tibia, so that the patella is really dislocated downwards from the femur. The lower fragment remains parallel to the upper.—From Malgaigne's 'Atlas,' pl. xiv. fig. 1.

satisfy himself that the epiphysial cartilage had been injured, he might warn the patient or his friends of the possibility of subsequent suspension of growth.

Fracture of the lower end of the femur is in general perfectly easy to diagnose. When the fracture runs transversely across the bone the lower fragment usually falls backwards by the weight of the limb, assisted perhaps by the hamstrings, and the mobility and displacement make the nature of the case obvious. If the separation be as low as the epiphysial line it involves the knee-joint, which will be more or less swollen; and this swelling may mask the other symptoms. Here also, the fracture being within the knee-joint, the attachments of its capsule hold the bones together, and prevent displacement from occurring, at any rate, to any great extent. But in such cases the loss of

power will indicate the probable nature of the injury, and attentive examination under chloroform can hardly fail to elicit definite proofs of it.

When the fracture runs down between the condyles it will often be found that the breadth of the lower end of the femur is perceptibly increased. The condyles may be movable on each other; and an important symptom of fracture running down into the joint is the sensation elicited by rubbing the patella over the condyloid notch. If there be any fracture its unevenness is very plainly felt, in contrast to the smooth motion of the kneecap, in the uninjured limb.

It may be added that in some cases the capsule of the knee-joint or even the patella itself, has been wounded by the upper fragment.

The treatment of such fractures is usually very successful. The bent position of the limb is best, both for the purpose of relaxing the hamstring muscles and of pushing the lower fragment into position by the projecting angle of the splint. The surfaces are so broad in fractures near the knee-joint that there is probably no shortening, and even when the fracture runs into the joint it often heals without producing any ankylosis. If ankylosis is apprehended it is desirable, after six weeks of rigid rest, to adapt some apparatus which can be removed daily or every other day, for the purpose of giving passive motion to a gradually increased degree, in order to obviate such a result. Should ankylosis have taken place it must be treated on ordinary principles, and will often yield to the treatment.

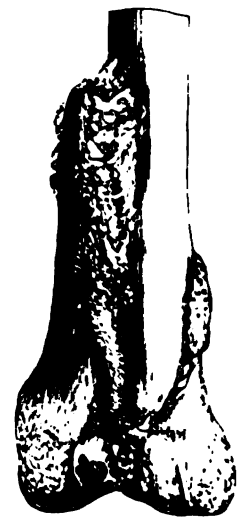


FIG. 123. Union of a fracture running down into the knee-joint. The patient, a middle-aged man, recovered with a very useful limb, and died a year afterwards from a different cause. The greater part of the fracture is united by masses of new bone, but there is no new bone in the interval between the fragments of the condyles, and the fragments of the cartilage are united by fibrous tissue.—St. George's Hospital Museum, Ser. I. No. 195.

Compound fracture into the knee-joint is an accident which, as a general rule, demands amputation; but to this general rule exceptions may be made in children and in unusually healthy young adults, if the surgeon thinks it justifiable. Mr. Canton has recorded two cases in which he excised the knee-joint for the secondary results of abscess in the joint, after an attempt to preserve the limb, in cases of simple fracture, or partial separation of the lower epiphysis of the femur; but amputation became necessary in both.[1] How far the same operation would be applicable in compound fractures into the joint is doubtful. In cases of gunshot fracture excision has hitherto proved very unsuccessful.

Fracture of the patella.

Fracture of the patella is a very common injury, and occurs in two main forms. The ordinary form of fracture is transverse, and is very commonly caused entirely by the action of the great extensor muscle, the bone being snapped by the muscle before the patient falls to the ground. But there are many cases (equal, according to some authors, to those caused by muscular action) in which the same transverse fracture is produced by direct violence.[2] In

[1] 'Path. Trans.' vol. x. p. 232; vol. xi. p. 195.

[2] Mr. Hutchinson remarks very truly, 'In the numerous cases in which direct violence is applied to the bone at the moment of fracture, there is almost always muscular contraction simultaneously present, and it is impossible to say which takes the chief share in the result.' 'Med.-Chir. Trans.' vol. lii. p. 328.

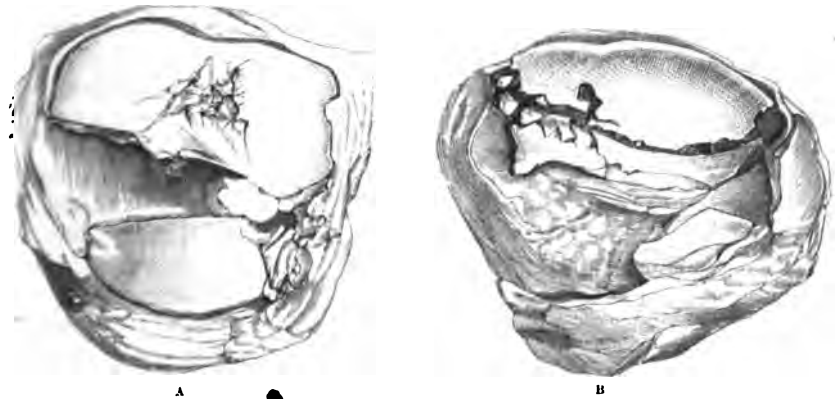
some cases disease of the knee has preceded and may have been a predisposing cause.[1]

The fracture, though called transverse, is often more or less oblique. It is accompanied by a laceration of the fibrous tissue covering the bone; and in proportion as this laceration extends completely through the aponeurosis of the extensor muscle the upper fragment is liable to be torn away from the lower by the action of the quadriceps extensor at the moment of the accident, or to be pushed up by the accumulation of blood and synovial effusion in the cavity of the joint. In some cases the fibrous investment remains entirely untorn, especially when the fracture is the result of direct violence. This is illustrated by Fig. 124, which also shows a peculiar cause for the fracture, viz. the direct impact of a fragment of the femur. Fig. 125 also shows the ligamentum patellæ untorn on one side.



Fig. 124. A transverse fracture of the patella, without laceration of the fibrous tissue in front of the bone, produced by violence acting from within, in a compound fracture of the femur, one of the fragments having, as it seems, been driven against the deep surface of the patella. The cartilage covering the patella is diseased.—From St. George's Hospital Museum, Ser. i. No. 205.

The symptoms are usually very plain. The patient may have snapped the bone before falling, or even with no fall at all (as in Boyer's case, where a coachman snapped his patella in making an effort to hold himself on to the coach-box). He will be almost or entirely unable to extend the limb; there will be swelling and effusion into the knee, and a depression will be felt between the two fragments, the upper one of which



A B

Fig. 125. A specimen of fracture of both patellæ, occurring in a severe injury, from the other effects of which the patient died 50 days after the accident. On one side (A) the fragments were widely separated, and there was no attempt at any union; on the other side (B) the ligamentum patellæ had not been completely ruptured; the fractured ends were in close apposition, and there was some amount of fibrous union. In both the cartilage bears very evident traces of inflammation. No record exists of the treatment beyond the fact that both knees had been put up in pasteboard splints before the final accession of the fatal symptoms, which were due to traumatic encephalitis after fracture of the base of the skull.

will be movable at a height above that of the upper border of the bone on the other side. Sometimes the bulging of the synovial effusion into the depression can be made out.

[1] See Fig. 124 in text; also Packard's 'Malgaigne,' p. 602.

Treatment. The foot and leg are to be placed on a straight splint properly padded. It used to be considered essential to raise the foot in order to relax the extensor muscle. But this is now regarded as a matter of little moment, for it has been noticed that after the direct results of the injury have subsided the quadriceps muscle is not contracted, but, on the contrary, quite flaccid and inactive;[1] and it has been found on trial that the results of treatment in the horizontal position of the limb are not inferior to those obtained in the raised position.[2] Still I am not aware that there is any valid objection to the raised position of the foot on a comfortable apparatus. I have often questioned patients so treated, who have complained of no inconvenience; but if they do find the position disagreeable I see no use in insisting upon it. The main point is to keep the limb extended and fixed in that position. The next point is to endeavour to bring down the upper fragment and keep it as near the lower as possible. This is often very difficult, from the persistence of effusion in the joint, and from the slight hold which can be got on the fragment. I have often employed Malgaigne's hooks, and have not experienced any bad effects from them. At the same time, cases have been recorded in which suppuration has followed, and even one, I believe, in which it extended into the joint, necessitating amputation. But such ill consequences are so rare as not to constitute, to my mind, any valid objection to the careful use of the hooks. I have found, however, that they have a uniform tendency to displace the lower edge of the upper fragment upwards, so as to render the space between the two fragments V-shaped, the angle backwards. Very close and useful union may, however, often be obtained by their means. It is desirable not to apply them till all active effusion has subsided, but it is not necessary to wait for the entire removal of passive effusion. Another plan—suggested, I believe, by Mr. Callender—which I have found useful, is to hitch under the upper edge of the upper fragment a bandage or strapping, to which a weight is attached, over a pulley at the end of the bed, so as to draw the upper fragment continuously and gently downwards. Numerous other plans have been introduced, but they may all, I think, be comprised under one or other of three heads, viz.: (1) To trust to nature, assisted or not by the raised position of the limb, to bring the fragments as near as is possible on the subsidence of the effusion; (2) To drag the upper fragment downwards by hooks fixed in the fibrous tissue above it; and (3) To draw it downwards by the traction of bandages or strapping applied to the skin over its upper end.

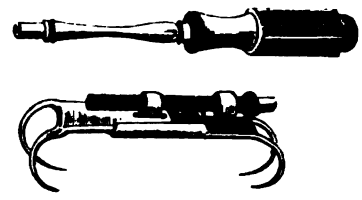


Fig. 126. Malgaigne's hooks for fractured patella. The hooks are fixed either into the skin and fibrous tissue above and below the fragments, or into plaster firmly applied in these situations, and the upper pair are then gradually approximated to the lower by means of the key and screw.

Recently, surgeons recognising the importance of the fluid effusion in the joint as a means of separating the fragments, have tested the effect of withdrawing the effused fluid with the aspirator as a preliminary to other treatment. Mr. Heath informs me that this practice has been followed in many cases at University College Hospital with uniformly good results, the fracture being then at once put in a plaster case.[3] In a patient recently under Mr. Dent's care at

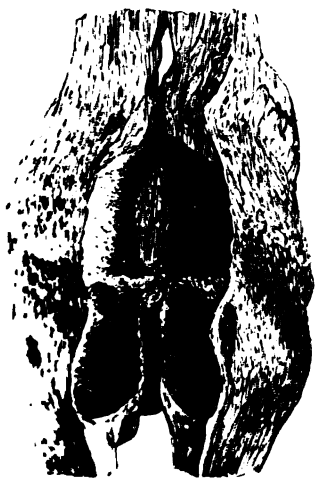
[1] Hutchinson, op. cit., p. 330. [2] Bloxam, in 'St. Barth. Hosp. Rep.' vol. iii. p. 386.

[3] See the debate on Mr. Croft's paper on the immediate treatment of fractures by the plaster-of-Paris bandage, 'Brit. Med. Journ.' vol. ii. 1881, p. 14.

St. George's Hospital, the separation being very considerable, about two ounces of bloody fluid were withdrawn by the aspirator a few hours after the injury, and the fragments greatly approximated by strapping. Next day, as the fluid had to some extent re-formed, a smaller quantity was again withdrawn and Malgaigne's hooks applied. The result was very satisfactory.

This fracture has also been treated without confinement to bed (except for a few days to allow the swelling and irritation to subside) by the application of an immovable apparatus carefully moulded to the leg and thigh.[1] In the case referred to the patient began to walk about the house on the fifth day after the accident—passive motion was commenced six weeks after the accident and voluntary motion three weeks later. The result is said to have been perfect, but the injury was probably not a severe one.

In some recent cases, the fragments have been united directly by drilling and wiring them together. It seems to me, however, that the natural results of the injury under ordinary treatment are not sufficiently disabling to justify a treatment fraught with such grave danger to limb and life, except perhaps in old ununited fractures where the limb is quite useless and the patient urges the operation.[2]



127. Union of fracture of the patella with hardly any separation of the fragments. The latter are enormously enlarged in all their dimensions, and their tissue much denser than natural. The interspace between them is filled with dense fibrous tissue, and is not more than one-third of an inch in extent. During life the union would have seemed bony.—From a preparation in the Museum of St. George's Hospital, Ser. i. No. 196. Nothing is known about the case beyond the fact that the man was in St. George's Hospital with fractured patella many years before his death.

Union.

The union of the ordinary transverse fracture of the patella, in which the fragments have been separated at the time of the accident by a considerable interval, is almost always by ligament, when it unites at all. It is true that many preparations of bony union exist and other specimens are found, as in the annexed figure, where the union appears bony externally, but on section is found to be partly or entirely fibrous. But there is no proof that in such cases the fragments have ever been separated; and, in fact, from the traces of inflammation always found in such fractures (as evidenced by the great thickening of the bone), it seems more probable *à priori* that they have been injuries due to direct violence, as in Fig. 124, above. No history has yet been put on record proving that the displacement in transverse fracture of the patella has ever been so effectually corrected as to admit of bony union. One specimen, however, does exist in the Musée Dupuytren referred to by Mr. Morris (op. cit. p. 1029), in which the union of a displaced fracture of the patella is bony. The increase in the vertical measurement of the bone is about an inch. The uniting bony material is thinner than the rest of the patella, and in Mr. Morris's judgment the union is less secure against subsequent violence than a stout ligament would have been. The cause of the ordinary want of bony union is evidently the separation of the fragments,

[1] Morgan, 'Boston Med. and Surg. Journ.' Nov. 29, 1877. 'Lond. Med. Rev.' Jan. 15, 1878.

[2] See Morris, op. cit. p. 1033, 34; also a paper by me on a case of this kind in the 'St. George's Hospital Reports,' vol. x. p. 495.

and when that separation has been very extensive it is common enough for the fragments to be entirely ununited.

The length of treatment must be regulated by our opinion as to the state of parts. We must not on the one hand keep the knee stiff for so long a time as to risk permanent ankylosis, nor on the other allow movement so early as to endanger the yielding of the ligamentous union. When the uniting ligament is short and strong the knee is very useful indeed; and it is doubtful whether bony union, accompanied as it generally is by much inflammation, is really better for the patient than a firm fibrous union.

As a general rule, the patient ought to be kept in bed for six weeks, and for at least six weeks more he should keep the limb in a splint which will not allow of any bending, after which he may use the leg cautiously, with a laced bandage having an aperture in front to receive the patella; but it must be understood that this time is a minimum. In cases where the separation is at all considerable, a much longer period of complete repose is necessary. The patient need not be confined to bed, but the joint must be kept perfectly



FIG. 128. A patella, showing a vertical fracture running from the base to the apex of the bone, so as to divide it into nearly equal halves. The fracture is joined above by a small oblique fissure ('Y-shaped fracture'), which however is not visible on the cartilage. On looking at the cartilaginous surface the principal fracture is seen to extend through the cartilage into the joint at the lower part only, and when traced upwards on this aspect is found to break up into two principal and numerous smaller fissures, which have no correspondence with the fracture of the bone. The patient, a young woman, had thrown herself out of a third floor window, in a fit of insanity, and died on the following day.—St. George's Hospital Museum, Ser. i. No. 187.



FIG. 129. Internal view of an oblique fracture of the patella, extending downward, from near the base to the apex of the bone. The articular cartilage is also cracked transversely.—St. George's Hospital Museum, Ser. i. No. 186.

immovable for at least six months from the accident. Otherwise the union will gradually weaken and stretch, or perhaps give way altogether.

The fracture is often reproduced by accidental rupture of the uniting ligament, and persons who have fractured one patella are liable to fracture the other. I have even seen a few cases where the patella has been broken a second time in a different place, the uniting medium of the old fracture remaining firm, and one in which this took place a third time.

Direct, vertical, or Y-shaped fractures.

The fracture which is purely the result of direct violence is sometimes star-shaped (or Y-shaped) or comminuted, at other times a mere longitudinal crack running more or less vertically. The ligamentum patellæ is generally untorn, and in fact the fracture often does not correspond on the two faces of the bone, so that no separation of the fragments is possible. There can, therefore, be no doubt that such fractures are susceptible of bony union, and preparations of such bony union exist in the College of Surgeons' and other museums. At the same time, the inflammation caused by the injury is doubtless more deleterious to the motion of the joint than the ligamentous nature of the

union in transverse fracture, allowing that in the latter case the bond of union is short.

Compound fracture of the patella.

Compound fracture of the patella is a rare and a very grave accident, usually accompanied by other injuries to the articulation, which necessitate amputation, but occasionally occurring alone, and then allowing the chance of saving the limb. The principles on which the surgeon must be guided in his choice, whether to save the limb entirely, or to excise the joint, or to amputate, are the same in this as in other injuries of the knee. Mr. Poland has tabulated all the recorded cases of this injury in vol. liii. of the 'Med-Chir. Trans.' and this record clearly shows that, in favourable cases, the limb may be preserved, and even that very useful motion may often be left. When the fracture is complicated with other injuries to the joint and surrounding parts so that some operation is necessary, Mr. Poland counsels amputation in preference to excision. When the limb is to be saved the wound must be accurately united, all loose and completely detached portions having been previously removed, and those which are loose but still attached being left to unite if possible. Then pressure and cold are to be applied. If suppuration comes on free incision is necessary, and now it may be advisable to remove fragments which may have become detached. Other successful cases of conservative treatment of this injury have been recorded since the publication of Mr. Poland's paper, one especially under Mr. James Lane's care ('Brit. Med. Journ.' July 1, 1876) in which the patient, a groom, obtained the complete use of the limb and probably bony union. On the failure of repair, indicated by the non-union of the wound, the grating of the bones under anæsthesia, and the decline of the patient's strength, amputation will be required in most cases. Mr. Poland speaks of the possibility of performing excision, and gives one case (under M. Verneuil's care) in which the patient having refused to submit to amputation, the operation of excision was actually performed with success.

Fracture of the leg.

Fracture of the leg is perhaps the most common accident which is met with in our hospitals, since most of the other common fractures are treated as out-patients. It occurs mostly in adult life, children being comparatively rarely the subjects of this injury; and as a general rule, when the fracture is simple, the patient recovers with no permanent disablement, though to this rule there are unfortunately numerous exceptions.

The fracture usually occurs at the junction of the middle and lower thirds of the leg, and both bones are usually broken, the fibula often at a higher level than the tibia; the lower fragment is generally displaced backwards, as though drawn by the gastrocnemius, so that its upper end projects under the skin, and sometimes punctures or perforates it. The displacement varies chiefly with the direction of the fracture through the tibia; when this is nearly or truly transverse there is often little or no displacement; when the fracture runs from the front of the bone obliquely downwards, the upper end of the lower fragment may be displaced behind the lower end of the upper; but generally the obliquity is in the reverse direction, or the fracture is comminuted, and then the displacement is as described above, combined very probably with some rotation of the lower fragment outwards. 'Out of nineteen specimens of united fracture of the leg' examined by Mr. Shaw, 'sixteen had the lower fragment rotated outwardly, and situated somewhat to the outer side and behind the upper.'[1]

[1] 'Path. Soc. Trans.' vol. ii. p. 125.

There is hardly ever any difficulty in the diagnosis. The cause should engage some attention. Generally the fracture is the result of indirect violence, as in falls on the feet. But it may be caused by a blow or kick on the part itself, which is of course accompanied by more bruising of the soft parts. The treatment is very simple in ordinary cases. The bones, being sedulously brought into exact apposition, are to be kept so for about eight weeks, when the patient may be allowed to use the leg, with merely the support of a bandage. The apparatus for maintaining the bones in apposition are very numerous. It is usual in hospital practice to apply side splints, i.e. two thin pieces of board, properly padded, cut somewhat to the shape of the side of the leg, and provided with a footpiece. These are kept on with straps and bandages, care being taken to see that the heel is well padded, so that the skin is not cut by the bandage, and to see that the foot is at right angles, otherwise the upper end of the lower fragment might be again displaced forward. The patient is then kept in bed for four weeks, after which the limb is encircled in pasteboard or leather splints for the other four weeks, and he is allowed to move about on crutches with the foot slung from the neck. But it is very common, particularly in the case of persons whose business renders it important for them not to be confined to bed, to put up the fracture in a pasteboard, plaster-of Paris, or other case, at once, if there is no bruising, or else as soon as the bruising has subsided; and the practice is a safe one, if care is taken in applying the bandage at first, and reasonable precautions observed afterwards to guard against subsequent swelling. I have never myself seen any ill consequences. Yet as the practice certainly involves some risk, in consequence of the withdrawal of the seat of fracture from the surgeon's observation, it may be well to explain this to the patient, and obtain his consent.[1] In fractures with much bruising, or comminution, or displacement, one of the plans recommended below for the treatment of compound fractures may be employed.

Fracture of the tibia.

Fractures of the tibia alone are much less common, since the force required to break this bone generally fractures the fibula also, and they are usually the result of direct force. The fibula acts as a kind of splint and prevents the separation of the ends, so that there is little, often no, displacement. They must be treated in the same way as fractures of both bones, and are peculiarly appropriate for putting up in a case directly after the accident, provided the state of the soft parts permits it.

Fracture of the fibula.

Fractures of the fibula alone are very common, the usual cause being indirect violence, as a false step, or slipping off the pavement, or falling with the foot jammed. The bone is generally fractured near the junction of the lower and middle third, though, especially when the cause is a direct blow, any part may be broken. The diagnosis is not always easy, for there is often no displacement, and the patient can in rare cases even walk.[2] Whenever a patient is totally or almost entirely unable to walk, and complains of fixed pain referred to a certain spot in the fibula on active or passive motion, fracture may

[1] A case was reported some years ago in which a surgeon put up a fracture of the leg (in a young child) in a plaster case immediately after the accident, and allowed the parents to take the child home. The parts swelled and the little patient became uneasy. The parents brought the child back to the surgeon. He was in too great a hurry at the time to make the proper examination by removing the apparatus. The whole skin sloughed, amputation had to be performed, and the surgeon was justly cast in damages.

[2] I once saw a case in which a patient had been walking, though with pain and difficulty, for some days after a fracture of the fibula. Still more rarely a patient can walk for a time with fracture of both bones.

be suspected. The best plan to detect it is to rotate the foot, keeping the fingers of one hand on the suspected part; or to press alternately on both sides of the supposed fracture. The existence of the fracture will be proved either by crepitus or by the fact that the upper part of the bone does not share the motion impressed on the lower fragment. If the surgeon remains in doubt whether the injury is a fracture or a severe sprain, he should treat it as fracture. When deformity exists there is no difficulty in diagnosis. The deformity consists in eversion or abduction of the foot, which is ascribed by Malgaigne and others to efforts made by the patient to walk, in which the foot, having lost the guard afforded by the external malleolus, is necessarily turned outwards. It is to remedy this displacement that the various formal plans of treatment are designed. Usually nothing is required beyond side-splints, or a case of pasteboard or plaster, since the displacement is easily remedied and there is nothing to reproduce it. The fracture should be kept in apposition for six weeks. The plans which are intended to act decidedly on the displacement are: 1. Pott's method—the patient being placed on the injured side, with the knee bent to relax the gastrocnemius muscle, the foot inverted, a splint applied to the inside of the leg, not reaching the foot, and a side-splint with a footpiece to the outer side of the leg and foot, the footpiece being more thickly padded than the leg, so as to turn the foot inwards. 2. Dupuytren's method, in which a straight splint is applied to the inside of the leg, reaching several inches below the foot; a wedge-shaped pad is applied, with its broad end downwards, corresponding to the internal malleolus. The foot and leg are bandaged to the splint, and by making the pad of sufficient thickness any amount of inversion of the foot which is judged necessary to disengage the lower fragment (which is supposed to be locked in or turned towards the tibia) can be secured.

Pott's fracture, or fracture of the fibula complicated with dislocation of the ankle, will be found treated of under the latter heading.

Compound fractures.

When fractures of the leg are compound the injury becomes much graver, and the treatment a matter of more anxiety. Many such fractures prove fatal in the practice of civil life from pyæmia or diffuse inflammation, and in military surgery they are still more fatal. The cause of the accident has much influence on the progress of the case. When, as often happens, the fracture was originally simple, but the patient in trying to move has pushed one fragment (generally the upper) through the skin, there is little or no laceration of the soft parts beyond the mere skin-wound, and there is generally no difficulty in getting the bones back into position with, or even without, a slight division of the skin, which sometimes tightly grasps the protruding fragment. But when the bones have been crushed by a heavy body passing over or striking the limb, and this force has at the same time carried the lower end of the leg backwards, the injury is often extensive and difficult to deal with: the soft parts are greatly contused and lacerated, the bones comminuted, and the comminuted fragments very likely much displaced, so that they can hardly be got into position by

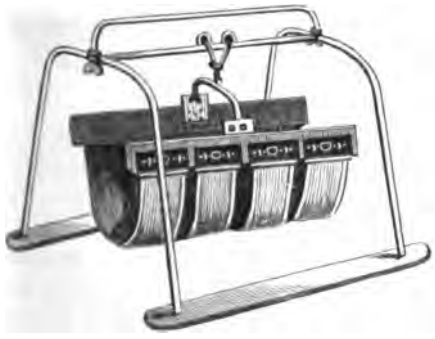


FIG. 130. Salter's swing.

any manipulation; besides which the periosteum is often stripped off the fragments to a great extent, rendering their subsequent death very probable.

The first question is, whether the limb can be saved or no; the next, whether to remove any of the fractured bone or no.

In resolving to save the limb or to amputate, the surgeon's first thought is as to the extent of laceration of the soft parts, since if this is so great as in his judgment to make traumatic gangrene inevitable, it would be folly to defer an operation which must ultimately follow, and which can never again be performed with so good a prospect of recovery. Again, if either of the main arteries is wounded it is better to amputate, at least in an adult. In a child or a youth perhaps it might be justifiable to wait till gangrene had commenced. And if the amount of exposed bone be very great, and the patient advanced in years or broken in health, it may be better to amputate. But the experience of modern surgery has shown conclusively how much may be done in saving limbs which would some time ago have been unhesitatingly condemned. Many of these cases have been brought to a successful termination by the 'antiseptic' method, and many by other carefully-devised plans of treatment. Without dogmatising on the subject, I believe I express the general opinion of surgeons of experience in saying that careful attention to the instant closure of the wound, graduated support, and exact apposition are more essential to success than any special application. Yet it seems rational to close the wound with a substance which is not in itself liable to putrefy, and which tends to preserve the parts below from putrefaction. Sir A. Cooper recommended lint steeped in the patient's own blood, believing that this would form a medium of union; but this is now rarely used. Many other substances are in use. Dry cotton-wool is an excellent application; or collodion, or the 'styptic colloid' of Dr. Richardson, may be employed; but of all substances which I have tried it seems to me that carbolised oil (about 1 of the acid in 6 or 8 parts) is the best. Before the parts can be reduced it is often necessary to remove a projecting splinter with the saw or bone-nippers; and I have removed as much as two inches of the tibia with perfect success. Great care should be taken to watch for any indication of the formation of matter, and to give it exit when necessary; and if general swelling of the limb or diffuse inflammation of the cellular membrane calls for it, free incisions should be practised. When reduction has been effected, the limb must be put upon a back-splint, with a footpiece, such as Macintyre's or Assalini's, which will hold the fractured

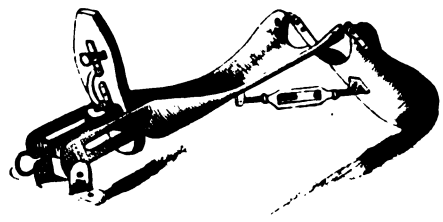


FIG. 131. Macintyre's splint, modified.



FIG. 132. Assalini's fracture-box. A, footpiece. B B B, buttons for attachment of straps, bandages, &c., to make pressure as required. C, screw for drawing the foot-piece downwards and so making extension, or increasing it from time to time. D, screw for altering the inclination of the foot-piece. E, a perforated pad attached to the knee, embracing and fixing the patella, and thus making counter-extension.

ends securely and yet give access to the wound. The wound is always on the front or side of the leg in fractures not caused by gunshot. In the latter some special contrivance must be extemporised, if the wound is in the calf.

Division of the tendo Achillis has been highly spoken of by some eminent surgeons,[1] as Mr. De Morgan, as a preliminary to the reduction of some simple and compound fractures of the leg, where the upper end of the lower fragment is much tilted forwards and reduction seems to be opposed by the tension of that tendon. The need for this measure may be inferred from careful examination of the limb under chloroform. If the tendon under these circumstances be still rigid, I have no doubt that much good may be obtained by its division, though in the few instances in which I have myself practised the operation I cannot say that it was successful in obviating deformity; and in one the wound suppurated extensively, and this suppuration much retarded the cure.

Finally, I may say that a certain amount of displacement, if unattended by much shortening, is not a very grave evil, and that in cases of displaced simple fracture it is better to acquiesce in this result than to run any risk of converting the simple into an inflamed and so into a compound fracture by injudicious attempts at complete reduction.

Fractures in the foot.

Fracture of the bones of *the foot* are singularly rare, considering the great frequency of falls and sprains in that part, showing the efficiency of the protection which the ligaments of the foot afford. They are met with, however, both as the result of direct and indirect force.

The os calcis is fractured from falls on the heel or from the passage of a wheel over the foot, and the nature of the injury may escape detection. This failure of diagnosis may be of little moment to the patient, since no apparatus is needed to keep the parts in position, and by the time he is able to put the foot on the ground the bone will be consolidated. But usually the increased breadth of the heel will point to the nature of the injury, and crepitus can be detected by proper manipulation. In some cases a fragment may be drawn up the leg by the action of the gastrocnemius.[2] All that is necessary is rest and soothing applications. When the fracture is compound and the fragments are completely severed, it may be well to remove the loose portions.

The astragalus can only be broken by indirect force, and when fractured the fragment is very often dislocated also, leading to the symptoms of dislocation. When this is complicated with a wound (compound fracture and dislocation) the displaced portion should be removed; otherwise the parts should be reduced and kept in position for about six weeks, when the power of standing and walking will probably be regained.

Fractures of the other bones of the tarsus call for no remark; indeed, as separate and distinct injuries they are unknown, though any of the smaller tarsal bones may be implicated in severe crushes.

Fractures of the metatarsal bones and phalanges require only rest, when simple. When compound the question of amputation is regulated mainly by the amount of the accompanying laceration.

Dislocation of the hip.

The dislocations of the hip-joint are usually described now, as they were by Sir Astley Cooper, as occurring in four chief directions: 1. Upwards and backwards on the dorsum ilii. 2. Backwards into the sciatic notch.

[1] See the first figure in the chapter on 'Tenotomy.'

[2] The tuberosity has been torn from the rest of the bone by muscular action, as evidenced by a case reported by Dr. Anningson of Burnley, 'Brit. Med. Journ.' Jan. 26, 1878.

3. Downwards into the obturator foramen. And 4. Inwards on to the pubes. Other dislocations, called 'anomalous,' are met with, which perhaps would be better styled 'uncommon;' the fact seeming to be (as stated by Mr. Bryant[1]) that 'there is good reason to believe that the head of the thighbone may rest at any point round its socket.'

The following are the features of the common dislocations:—

1. In dislocation on to the dorsum ilii the limb is considerably shortened, and is inverted, so that the knee points inwards over the lower part of the uninjured thigh, and the toes rest on the instep of the sound foot. The trochanter major is elevated, lying nearer the spine of the ilium than natural, and is turned outwards, so that the buttock is broader and flatter than the other; the head of the bone is to be felt on the dorsum, more or less distinctly according to the fatness of the parts. Voluntary movement is abolished, and passive motion (which, it should be observed, elicits no crepitus) is nearly abolished in all other directions, but may be effected to a slight extent in the direction where the displacement points; i.e. flexion, adduction, and internal rotation.

The diagnosis of this injury is generally very easy—from fracture of the neck of the femur by the fixed position of the limb, the absence of crepitus, and the position of the bone on the dorsum ilii—from dislocation the result of disease by the history of the case—and from the other dislocations by the symptoms which will be immediately described.[2]

Mode of causation of dislocations of the hip.

Opinions differ as to the causation of the various dislocations of the hip. The simplest theory, and one which is powerfully supported by the method of production of these dislocations on the dead subject, is that which Mr. Morris has defended in a very interesting paper in vol. lx. of the 'Med.-Chir. Trans.'[3] It is, that all dislocations of the hip are the result of forced abduction of the femur, and 'that the posterior dislocations result when flexion and rotation inwards accompany abduction' (the sciatic being caused by a greater degree of flexion and inward rotation than that which produces the dorsal), 'and the anterior when extension outwards accompanies abduction, while the downward or thyroid variety occurs during abduction unaccompanied by rotation.' This theory has been questioned by Mr. Eve ('Med.-Chir. Trans.' vol. lxiii.) He inclines rather to the opinion of Sir A. Cooper, that most of the dislocations backwards are *direct*, i.e. that the femur is at the time flexed and abducted, and is then forced directly through the back of the capsule. The controversy is an interesting one, and both papers are the more valuable from containing careful accounts of the dissection of recent dislocations. I believe that both methods occur, i.e. that the head

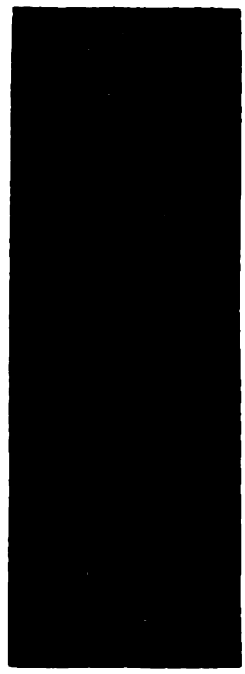


FIG. 133. Dislocation on the dorsum ilii.

[1] Bryant's 'Practice of Surgery,' 2nd ed. vol. ii. p. 338.

[2] Mr. Morris calls attention to a symptom which he says may always be verified in all dislocations of the hip backwards, whether recent or old—viz., the loss of support from behind to the large vessels in the groin. In some cases the outline of the acetabulum can be made out by firm pressure along the line of the femoral vessels (op. cit. p. 1063).

[3] Also in his article on Injuries of the Lower Extremity, 'Syst. of Surg.' 3rd ed. vol. i. p. 1056.

of the bone may be driven directly through the back of the capsule while the limb is flexed (its position on the dorsum or in the sciatic notch depending probably on its degree of flexion), or indirectly from laceration of the internal part of the capsule in abduction, the head of the bone being directed on to the dorsum ilii or sciatic notch by the subsequent movements of the limb or trunk; but which is the more frequent method is a very obscure question. The forward dislocations occur no doubt in abduction of the limb, the head of the bone being directed on to the pubes, when the patient is at the same time falling backwards, while the foot is fixed, as in Sir A. Cooper's friend, who suffered this injury from falling backwards while his foot was jammed in a hole in the pavement.

Parts injured in dislocation backwards.

The parts injured in dislocations of the hip backwards are the capsule, the round ligament, the external rotators, to a variable extent, and more rarely the glutei—even in some cases the gluteus maximus and occasionally the sciatic nerve. The psoas and iliacus muscles are put on the stretch.[1]

Reduction.

The period at which reduction can be effected was fixed by Sir A. Cooper at about two months—and this seems to be true in general—for, though dislocations have been successfully reduced at very long periods after the injury,[2] it must always be doubtful whether more harm will not be done by the necessary force than the prospect of benefit from the reduction of the bone justifies. This must be left to the judgment of the surgeon, founded on the symptoms of the case before him, and the result of careful examination under anæsthesia. But it may be observed that the attempt is far more hopeful and far more justifiable, now that anæsthetics are used, than it was in Cooper's time. The obstacle to reduction is not only that the head of the bone will probably have contracted adhesions to the neighbouring parts—for these adhesions will most likely yield to properly applied force—but that the shape of the parts may have changed, the acetabulum being more or less filled with inflammatory deposit, and the head of the femur enlarged by inflammation, and resting in a new socket which it has worn for itself on the dorsum ilii.[3] But this is by no means always the case. Thus, Mr. Brodhurst says that he has found the cotyloid cavity retaining its depth and covered with cartilage after the head of the femur had been dislocated for three years, and refers to a case in which Fournier found the acetabular cavity perfectly natural thirteen years after dislocation; and from these cases he infers that the altered shape of the head can never prevent the return of the bone into the articular cavity.[4] However, I cannot but believe that inflammatory changes do sometimes go on, both in the dislocated head and in and around the articular cavity, which render the secure reduction of the joint impossible; and that the presence or absence of these changes depends in a great measure on the amount of motion of the parts.

There has been a great change in recent times in the proceedings for reducing a dislocation of the hip. Sir Astley Cooper, who was the great authority on this subject, taught that the difficulty in reduction depended mainly on the resistance of the muscles, and prescribed that this resistance should be overcome by traction exercised very much in the line of the dislocated femur. The patient was accordingly to be laid on his back and the

[1] Morris, 'Syst. of Surg.' 3rd ed. vol. i. p. 1060.

[2] Mr. Erichsen gives reference to several cases in which old dislocations have been reduced. The longest period, however, for the hip is seventy-eight days.

[3] For an example of the enlargement of a dislocated bone, and the new socket formed on the surface upon which it rests, see the head of the radius in the drawing of old dislocation of the elbow, Fig. 95, p. 265.

[4] 'St. George's Hospital Reports,' vol. iii. p. 70.

limb extended by pulling the knee in a direction crossing the lower third of the opposite thigh; the pulleys being generally used and applied to the femur just above the condyles, while the pelvis was fixed by a perineal band to a staple behind the patient's head. But, since the use of anæsthetics, dislocations are generally reduced without any such expenditure of force, and the success of the 'flexion-method' lends additional probability to Bigelow's opinion, that the obstacle to reduction is to be found, not in the muscles, but in the resistance of the fibrous capsule of the joint, and mainly of that excessively strong part of it which is usually described as 'ilio-femoral,' and which he describes and figures as the 'Y-ligament,' the fibres bifurcating, more or less clearly below at its attachment to the anterior trochanteric line, so as to resemble the letter Y reversed. That the ligament sometimes has this arrangement is indisputable, and it is equally indisputable that in many cases (I think in the great majority) no such disposition of the fibres can be shown to exist unless made by the dissector. Nor does Bigelow describe it as a constant structure. His words are: 'The divergent branches of the Y-ligament are sometimes well developed, with scarcely any intervening membrane. In other cases the intermediate tissue is thicker, and requires to be slit or removed before the bands are distinctly defined; and sometimes the whole triangle [i.e. the



FIG. 134. Reduction of dislocation on the dorsum ilii. By Sir A. Cooper's method.

whole ilio-femoral ligament] is of nearly uniform thickness.' Anatomically, therefore, I consider the descriptions in the ordinary text-books more correct than one would be which should adopt Bigelow's description of the occasional disposition of this ligament as being universally met with. But this is a matter of very slight moment. What is really important, and what, I think, is perfectly indubitable, is that the chief symptoms of dislocation and the chief obstacles to its reduction are caused, not by the muscle, but by that part of the capsule of the joint which remains untorn;[1] and that flexion of the thigh by relaxing this part of the capsule is the essence of success in reduction. Anyone can convince himself of this who will take the trouble to produce these dislocations on the dead subject. He will then see that in all forms of dislocation the capsule is torn away freely (though to a variable degree) from the rest of the acetabulum, but that the upper and outer part of the capsule and the ilio-femoral ligament—representing the two branches of Bigelow's Y-ligament—remain untorn; and he can easily satisfy himself that by extending the limb this powerful ligament is at once put on the stretch, and that if a dislocation be reduced by force applied in that direction it can only be at the expense of some laceration of the untorn part of the capsule. It will also at once strike the experimenter that the reduction of the dislocation must be most easily

[1] The inversion is clearly caused by the tension of this powerful ligament.

effected by a reversal of the manipulation by which it can be produced. This manipulation is carefully described in Professor Fabbri's work[1] for all the usual kinds of dislocation of the hip. That on the dorsum is most easily produced as follows. The thigh is to be forcibly abducted till the ligaments are heard to crack—i.e. till the capsule is torn off the inside and back of the acetabulum. Now the limb is flexed, rotated violently inwards, and driven up by pushing the bent knee upwards, and so the head of the bone is lodged on the dorsum. It can be brought down again into the acetabulum with the greatest ease by rotating it outwards again and pulling it towards the joint. A previous subcutaneous division of the fascia lata by a transverse incision above the trochanter renders the manipulation easier.

Assuming, then, that it is mainly the tension of the untorn portion of the capsule which resists the reduction of the head of the bone, and that this tension is lessened by the flexed and increased by the extended position of the thigh, the ease with which dislocation of the hip is often reduced under chloroform by manipulation is readily explained. The necessary manipulation is as follows: The patient is placed on his back on the floor, completely anæsthetised, the surgeon flexes the leg on the thigh, and the thigh completely on the pelvis, and then abducts the limb. All this is easily done with the left hand; or, if the limb is very large, should be done by an assistant, who will be careful to follow, and not impede, the surgeon's movements. Then the thigh is grasped by the knee, and powerful rotation made *out*wards: and if this does not succeed, *in*wards.[2] Or, the thigh being flexed, the surgeon may put his foot (having, of course, taken his boot off) on the pelvis, and lift the head of the bone up into its place by traction on the bent knee. Bigelow also describes the same method, but reversed, by suspending the patient's knee across a board, and with the buttocks supported a few inches from the floor. The surgeon then with his foot thrusts the pelvis down, so bringing the acetabulum down to the femur, or sometimes the weight of the body will of itself reduce the dislocation (automatic reduction).[3] If manipulation does not succeed the pulleys must be employed; but it seems better to place the patient on his side and make traction on the bent knee (as Sir Astley recommends in the sciatic dislocation), rather than by direct extension to endanger further rupture of the ilio-femoral ligament.

Dislocation into the sciatic notch.

2. Dislocation of the head of the femur into the sciatic notch, or dislocation backwards, is a variety of the dorsal dislocation, and one which, if we adopt Bigelow's views, need not be described separately from it. It is distinguished from the dislocation on the dorsum merely by the symptoms being less marked; there is less shortening, flexion, and inversion;[4] the knee being only slightly advanced, and the great toe of the affected side resting on the ball of the opposite great toe. The head of the bone is also much less perceptible, from its being sunk more or less into the notch, and from the mass of muscle which covers it, and passive motion is almost abolished, except in the sense of flexion, in consequence of the locking in of the head of the femur.

I have described this dislocation according to the accounts left by the best

[1] 'Sulle luzzazioni traumatiche del femore.' In the 2nd vol. of the 'Memorie della Soc. Med. Chir. di Bologna,' 1841. It is much to be regretted that this work is so little known in this country, never having been translated into English.

[2] 'Flexion lies at the foundation of success in the reduction of femoral dislocation, and compared with this the rest of the manipulation is of secondary importance.'—Bigelow, p. 29.

[3] Crosby and Allen, 'N. Y. Arch. of Clin. Surg.' i. 269.

[4] There are other cases, however, in which the inversion is even greater than in the dorsal dislocation.

authors, and which, as far as my memory serves, correspond to the phenomena of those dislocations which I have seen, in which the head of the bone has been thought to be in the sciatic notch. At the same time we must recollect that Professor Bigelow has asserted that there is no proof that the head of the femur was really lodged or impacted in the sciatic notch in any case; nor am I aware of any post-mortem examination which absolutely proves that the head of the bone was driven into, or impacted in, the sciatic foramen. In the cases referred to by Mr. Quain ('Med.-Chir. Trans.,' vol. xxxi.), as dissected immediately after the injury by himself and Béclard, the head of the bone lay rather between the two notches—i.e. on the spine of the ischium —than in the foramen. In Mr. Syme's case ('Contrib. to Path.' p. 277) the head of the bone was embedded in the torn fibres of the gluteus maximus, 'lying in the great ischiatic notch upon the gemelli and the great sacrosciatic nerve.' It could not, therefore, have been impacted in the foramen. Nor in experiments on the dead body have I ever succeeded in driving the head of the bone *into* the foramen, though it may easily be lodged anywhere near it; and, in fact, the entire passage of the head of the femur into the sciatic foramen is impossible, from their relative sizes. That Sir A. Cooper's description does not apply to all dislocations called sciatic is plain enough from reading the cases described by Quain, Wormald, and others;[1] but I think it is going too far to say with Bigelow that the dislocation should not be separately described, or with Malgaigne that it is an invention of Sir Astley Cooper's. Prof. Fabbri has described two kinds of the posterior luxation



FIG. 135. Dislocation into the sciatic foramen.



FIG. 136. Reduction of dislocation into the sciatic notch, by Sir A. Cooper's method.

[1] Mr. Samuel Lee has related an interesting case of dissection of a recent dislocation of the hip backwards, in which the head of the bone was situated below the pyriformis muscle and immediately behind the acetabulum. Here the capsule of the joint was freely lacerated all round, a small portion only remaining attached to the femur in front and behind, and 'in manipulation it was found,' says Mr. Lee, 'that the muscles were the main obstacle to reduction.'—('St. George's Hospital Reports,' vol. vii. p. 169.) See also Mr. Eve's paper, 'Med.-Chir. Trans.' vol. lxiii.

—one which he calls 'ischiosciatic,' in which the head of the bone rests just behind the acetabulum, and which corresponds to Bigelow's 'dorsal dislocation below the tendon of the obturator internus,' both in the position of the neck with regard to that tendon and in the great inversion of the limb; while in the other kind, which he calls 'sacrosciatic,' the head of the bone is carried farther back, so as to lie on the sciatic notch. It is far less perceptible from the surface of the body, and all the characters of the injury correspond exactly to those described by Cooper. The experiments by which these two forms of dislocation may be produced at will on the dead subject are minutely described in Fabbri's work.

The method of reduction is very much the same as in the dorsal dislocation. Sir A. Cooper directs that the patient be placed on his sound side and the limb drawn across the opposite thigh—i.e. somewhat flexed—in order to disengage the head of the bone from the notch; and if the flexion be a little more than Sir Astley figures, the method will in all probability succeed.



137. This figure shows the head of the bone in its socket, with the obturator tendon in its natural position behind it. The part of the capsule which lies beneath the tendon and behind the Y-ligament has been slit, both to demonstrate its thickness and to allow the head of the bone to rise as high as the ischiatic notch.—After Bigelow.



FIG. 138. This figure shows the head of the bone dislocated below the tendon into the neighbourhood of the sciatic notch. If the tendon were not present the capsule would produce much the same effect in binding the head of the bone close upon the ilium without the interposition of the muscle.—After Bigelow.

Pulleys, however, are usually unnecessary, since the bone can be reduced by manipulation quite easily, in the same way as the ordinary dorsal dislocation.[1] Indeed, the only difference which Professor Bigelow recognises between the two dislocations is, that he believes the head of the bone to have escaped from the cavity of the joint below the tendon of the obturator internus in the sciatic dislocation, while in the other it has passed out either above or through the rotator muscles. But although the rent in the capsule may be below the obturator tendon, the head of the bone, according to this author, rests usually upon (i.e. behind) the tendon. And he denies that any dislocation of the hip really exists which deserves the name of a dislocation *into* the sciatic notch, or that that notch ever causes the difficulty in reducing the dislocation. The obstacle to reduction he places in the resistance of the Y-shaped ligament and the tension of the obturator internus muscle, which is now placed in front of instead of behind the head of the bone, and is therefore interposed between it

[1] 'See a case by Mr. Wormald in which the dislocation was reduced by flexion six weeks after the accident, when pulleys had been used in vain.—'Med. Times,' Aug. 16, 1856.'

and the acetabulum. The same manipulation as is used in the common dorsal dislocation will relax and overcome these obstacles. The Y-ligament being relaxed by flexing the thigh to a right angle, the same manœuvre draws the head of the bone down below the tendon towards the rent in the capsule by which it escaped, when the depression of the pelvis or the lifting of the thigh will probably reduce it; or it can be slipped into the socket by rotation outwards.

A very clear description of the sciatic dislocation, and one which corresponds to what I have seen of this lesion both in the living subject and in experiments on the dead, much more nearly than Bigelow's, is to be found in a small work by M. Tillaux.[1] He regards this dislocation as being quite a distinct and separate injury from that on the dorsum ilii. It is produced, according to him, by violent rotation inwards of the thigh while in a position of forced flexion, and he states that the difference in the situation of the head of the femur depends on the different portion of the capsule which is left untorn. M. Tillaux's explanation is as follows: In every dislocation of the hip backwards the capsule must be torn away from all the posterior and lower portion of the acetabulum. But partial dislocation backwards is possible while the upper portion of the capsule remains entire, comprising about one-third of its circumference. Such partial dislocation M. Tillaux regards as a constant and necessary initial stage of the complete dislocation, and he believes that it not unfrequently occurs in practice—the head of the bone still remaining in contact with the border of the acetabulum. If now the anterior portion of the still untorn capsule should give way, leaving only the upper and back part attached to the acetabulum, a sciatic dislocation results—if the posterior gives way, and the anterior portion is left, i.e. if the iliofemoral ligament alone remains, the dislocation will be on to the dorsum. This author divides the sciatic dislocation into three kinds—an upper one, in which the head of the bone lies over the great sciatic foramen, of which he figures a specimen drawn from an unreduced dislocation; a middle, in which the displaced bone lies on the spine of the ischium; and a lower, in which it is opposite the small foramen. His experiments also entirely negative the theory that the position of the head of the bone depends in any degree on the obturator internus, or any other muscles. 'In sciatic dislocation,' says M. Tillaux, 'produced on the dead subject, I have dissected all the muscles, and then found that it is impossible to drive the head of the femur upwards ever so little. I have then divided in succession the obturator internus, gemelli, pyramidalis, gluteus medius, minimus, quadratus, and finally obturator externus, so that the bones were only held in their relative position by the untorn part of the capsule. Still the head of the femur is as immovable as before the muscles were cut. If now the capsule be divided by gradually nicking it, the head of the femur becomes movable just in proportion to the extent of the cut, showing that the position of the bone depends entirely on the untorn part of the capsule.' M. Tillaux does not say so, but his experiments tend to show that the obstacle to reduction must also reside chiefly if not solely in the capsule.

A glance at Fig. 138, and at the figures on p. 306, will, I hope, make the theory of reduction by flexion intelligible, so far at least as it is admitted by surgeons. In the dorsal dislocations the head of the bone lies behind the Y-ligament (adopting Bigelow's terms) and above the acetabulum. Flexion relaxes the ligament and also the tendons (obturator internus and others)

[1] 'Recherches expérimentales et cliniques sur le mécanisme de la production de luxations coxo-fémorales en arrière.' Par P. Tillaux: Paris, 1876.

which are on the stretch, and then rotation outwards with abduction draws the head of the bone down towards the socket. In the dislocations below the Y-ligament, on the other hand, the head of the bone, being below the socket, is most easily directed into it by rotation inwards.

Dislocation into the obturator foramen.

3. Dislocation downwards or on to the obturator (thyroid) foramen is a much less common accident than those above described. It is a well-marked injury, differing from all the other lesions about the hip-joint in the fact that the limb is really lengthened,[1] at least it is so in some cases; while in others (as in one under my own care and another under that of Mr. Rivington[2]) the lengthening is only apparent, and is due to inclination of the pelvis. The limb is abducted and is also usually somewhat everted. The muscles on the inner side of the limb will be found to be on the stretch, forming, in Fabbri's



Fig. 139. Dislocation into the obturator foramen.



Fig. 140. Reduction of the obturator dislocation. After Sir A. Cooper's method.

language, 'a tense cord parallel to the axis of the thigh, beginning at the spine of the pubes, widening as it descends, and disappearing in the middle of the thigh.' There is considerable pain, probably due to stretching of the obturator nerve. The trochanter is less prominent than natural, sometimes forms a deep depression, and the fold of the buttock is lower than on the other side.

I have seen the method of reduction shown in Sir A. Cooper's plates used with prompt success in this dislocation more than once. This method is as follows:—A band is passed round the perinæum, and is hitched under the

[1] In the early stages of hip-disease the limb *appears* to be lengthened, but this appearance is deceptive.

[2] 'Med. Times and Gaz.' Oct. 27 and Nov. 3, 1877. The limb may even be shortened. Morris, op. cit. 1076.

belt which steadies the pelvis. The latter encircles the two iliac spines, and is fixed into a staple in the wall on the patient's sound side. The perinæal band is attached to the pulleys on the patient's injured side and somewhat behind his head, so that extension draws the head of the femur upwards and outwards, i.e. towards the acetabulum. The surgeon grasps the foot and draws it across the middle line of the body—thus also prising the head of the bone outwards—and reduction is then is most cases easy. The flexion-method consists in the following manipulation: The patient being laid on the floor, the hip is flexed to a right angle, so as to relax the Y-ligament, and the knee is bent acutely, to give a purchase for the surgeon's hands. The limb is a little abducted, to disengage the head of the femur; then the thigh is rotated strongly inwards and abducted, the knee being carried down to the floor. The effect of this manœuvre is thus described by Bigelow: 'The trochanter is fixed by the Y-ligament and the obturator muscle, which serve as a fulcrum. While these are wound up and shortened by rotation the descending knee prises the head upward and outward to the socket.' But, according to the same author, rotation outwards will also succeed in some cases, and he gives an instance in which the dislocation was so reduced after the inward rotation had failed.



FIG. 141. Reduction of thyroid dislocation by rotating and circumducting the flexed thigh inwards. After Bigelow.

This dislocation may also be reduced by flexing the limb and drawing the head of the bone outwards by means of a towel passed round the upper part of the thigh, or by placing the patient with a post between his legs (the bed-post is generally used) and prising the head of the femur outwards by crossing the foot inwards. Or the limb may be flexed upwards and outwards, and the head of the bone dragged or jerked directly towards the socket. I used this manipulation with success in a case under my care, after attempts by circumduction inwards had failed. The patient was a young muscular man, and the dislocation had only occurred an hour or two previously. Having failed to reduce the bone by the method figured above, I stood over the patient, his pelvis being steadied by assistants, placed my right foot on the horizontal ramus of the pubes, and dragged the flexed



FIG. 142. The mechanism of the manœuvre shown in the previous figure is here seen. The inner branch of the Y-ligament being wound round the neck, the head must rise towards the socket as the femur is depressed inwards. After Bigelow.

thigh directly upwards towards the acetabulum, rotating and jerking it, in order to disengage the head from any intervening obstacles, and lift it over the brim of the acetabulum. After about a minute of this manipulation the head returned into the cavity.

Bigelow agrees with Sir A. Cooper in stating that in the manipulation of reduction the obturator may be converted into a sciatic dislocation, but he does not seem to see any disadvantage in this. In fact, regarding the dorsal dislocation (of which the sciatic is a variety) as one easy to reduce, he recommends that in case of difficulty in reducing the obturator dislocation it should be converted into a dorsal, and then reduced as above.

Bigelow also describes several other methods of reducing this dislocation, which I think it unnecessary to quote. From the ease with which the few cases of obturator dislocation that I have seen have been reduced by Cooper's method, I should be myself disposed to have recourse to it when moderate attempts by manipulation in the various ways above described had failed.

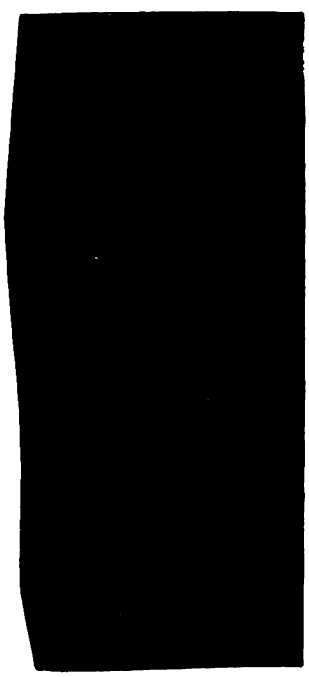


Fig. 143. Dislocation on the pubes.

4. The last of the four regular dislocations of the hip is that upon the pubes, which, however, is not a common accident. I can only remember seeing one instance of it; and Bigelow, whose experience of these accidents appears to have been large, says he had never met with it in the living body. Dislocation on the pubes.

It seems that the head of the bone may lie either in front of (and more or less upon) the horizontal ramus of the pubes, or on the ilium below the anterior inferior spine;[1] and the further inwards the head of the bone has been thrown the further outwards must the lower part of the limb be turned. The main features of this dislocation are the eversion of the foot, with slight shortening, and more or less abduction. The head of the bone being very readily felt will prevent any possibility of confounding this injury with fracture of the neck of the femur. In reference to the Y-ligament, the dislocation would be described as above the ligament, and Bigelow believes that the eversion, which is so prominent a symptom in this injury, is produced partly by the tension of the obturator internus muscle, but mainly by that of the ligament, which embraces the neck of the bone.

The method of Sir A. Cooper consists in drawing the dislocated limb down in hyper-extension, so as to disengage it from the pelvis, and then by passing a

[1] The reader may be referred to an interesting paper by Mr. Cadge of Norwich, in the 44th vol. of the 'Med.-Chir. Trans.' which contains a very clear description and a representation of the dissection of a case, rendered doubly important by the fact that its symptoms were related during life by the younger Travers (in the 20th vol. of the same series), and that was quoted in one of the editions of Sir A. Cooper's great work (5th ed. p. 95) as an instance of dislocation on the pubes. The head of the bone lay, however, really not on the pubes but on the ilium, occupying the interval between its two anterior spinous processes; and Mr. Cadge refers to four other cases, two of them verified by dissection, where the head of the bone was in this position; and on account of this frequent inaccuracy (speaking strictly) of the ordinary nomenclature, Mr. Cadge would substitute the term 'dislocation under the femoral arch,' or 'upwards and forwards,' which would no doubt be more correct.

towel under the upper part of the femur the head of the bone is directed towards the acetabulum and lifted over its edge, the limb being rotated inwards at the same time, if necessary, by grasping the knee and ankle.

The flexion method is also very successful. Under chloroform the difficulty in flexing the thigh will be overcome by drawing the bone downwards, then it is to be rotated inwards or outwards, and directed towards its place by slight rocking movements; or manipulation differing only slightly from that employed in the obturator dislocation may be used, which Professor Pirrie[1] (who had two successful cases) thus describes: 'Flex the thigh on the abdomen, adduct,[2] rotate inwards, and bring down the knee.' Or the dislocation may be treated by extension of the thigh, with counter-extension by the heel in the perinæum, as in dislocation of the humerus; and during this manœuvre Bigelow recommends to bring the patient into a sitting posture, press the foot against the pubes, and rotate inwards.

Unusual or anomalous dislocations.

The anomalous dislocations of the hip on record have by this time become tolerably numerous. I am not sure that a description of them would be worth the space required. The one which is of most consequence is that

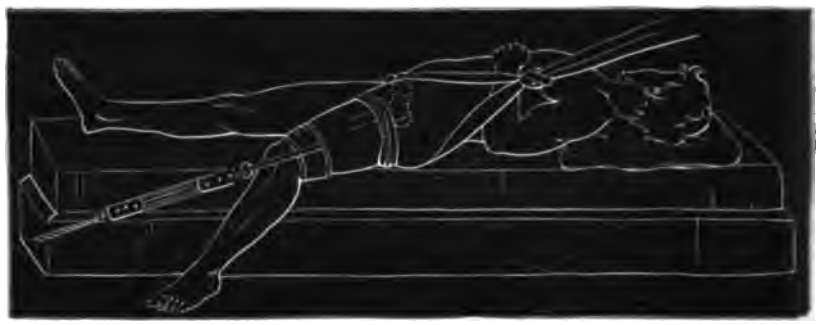


Fig. 144. Reduction of dislocation on the pubes by Sir A. Cooper's method.

variety of the dorsal dislocation in which the limb is everted, called in Italy 'Monteggia's dislocation,'[3] in which the affected limb is crossed more or less over the other and rotated considerably outwards—the head of the bone lies near the anterior superior spine of the ilium, and the trochanter is very prominent. The chief element in the production of this dislocation is, as Fabbri has shown, violent rotation of the flexed thigh outwards, and it can be reduced by a manœuvre not very dissimilar to the reduction of the dorsal dislocation. The limb is to be moderately flexed, slight movements of internal rotation and 'wagging' movements are to be given to it, and, if necessary, the head of the bone is at the same time to be directed by pressure towards the acetabulum.

[1] 'Principles and Practice of Surgery,' 3rd ed. p. 425.

[2] Mr. Stokes ('Brit. Med. Journ.' Dec. 11, 1880) dissents from this rule, and believes that abduction of the limb is preferable. He gives a very interesting history and dissection of a case in which the head of the bone was dislocated above the pubes. A good deal of difficulty was experienced in reducing the dislocation, which was at length effected at a second sitting, under anæsthesia, by abduction of the flexed limb and rotation inwards, which brought the head of the bone into the obturator foramen, from whence it was reduced by external rotation. The patient died very soon afterwards; and it was then found that the head of the bone had been dislocated above and partially behind the pubes. There was in this, and in another case which happened about the same time under Prof. Bennett's care, an absence of the characteristic inguinal tumour, in consequence of the sinking of the head of the bone into the pelvis. Mr. Stokes proposes the name of 'suprapubic dislocation' for this injury.

[3] Fabbri, op. cit. p. 609. Bigelow, p. 92. Morris, in 'Syst. of Surg.' p. 1072.

Other anomalous dislocations are those *downwards*, in which the head of the bone has passed beyond the obturator foramen into or near to the lesser sciatic notch,[1] *backwards and downwards*,[2] where it is lodged between the spine of the ischium and the acetabulum; and finally that in which the head of the bone is thrown *forwards* into the perinæum.

Some amount of fracture of the acetabulum tolerably often, as it seems, complicates dislocation. I have already remarked on the point (p. 228), and need only add that the reality of the injury was proved by dissection in Mr. Quain's, Mr. Eve's, and other cases, as well as by almost unmistakable symptoms in many which have not been dissected.

Dislocation of the knee.

Traumatic dislocations of the *knee* are as rare as pathological dislocations are common—a surprising testimony to the efficacy of the mechanism of the joint, since the articular surfaces are so flat and so little adapted in shape to each other that we should have expected them to have been easily displaced; but the firm capsule, the great tendon in front of the joint, the powerful crucial ligaments, and the strong muscles around hold these large flat surfaces so securely together that we very seldom see even partial dislocation, and complete dislocations are amongst the rarest accidents in surgery.

The usual dislocation is a partial dislocation laterally, the internal articular surface of the tibia being thrown on to the external condyle of the femur, or *vice versâ*. The alteration in the shape of the limb and in the axis of its two parts is so characteristic that the injury can hardly be mistaken, though, as Mr. Holthouse has pointed out, a separation of the lower epiphysis of the femur may at first sight present some resemblance to this dislocation. The dislocations of the tibia forwards or backwards are sometimes complete; and in such cases, particularly when the tibia is carried forwards, the popliteal vessels may be so stretched by the projection in the ham that gangrene may ensue. The nature of the injury is obvious.

Reduction in all these injuries is generally easy, for they are necessarily accompanied by great laceration of the neighbouring structures. If the skin is also torn, so that the dislocation is compound, amputation will be the safest course under ordinary circumstances, though in young subjects and in the simpler cases the surgeon may justifiably make an attempt to preserve the limb.

Dislocation of the patella.

The patella may be dislocated on to either condyle of the femur, an accident which usually occurs from a blow on the part, as from a fall on the edge of the bone, but sometimes from muscular action only. The patella is more commonly thrown on to the outer than the inner condyle; in fact, it is believed that the dislocation inwards is only possible in persons whose ligaments have been previously relaxed.[3] The symptoms when the dislocation is complete are characteristic; 'the articular surface of the patella rests on the outer side of the condyle, with its inner margin directed forwards; the breadth of the knee is increased, the limb is slightly flexed and fixed, and any attempt to move it from this position causes great pain.' If the dislocation is incomplete—i.e. if any portion of the articular surface of the patella remains in contact with the trochlear surface of the femur—the symptoms are less marked, though similar.

In order to reduce the dislocation the quadriceps muscle must be relaxed

[1] Luke, 'Med. Times and Gaz.' June 2, 1858.
[2] Adams, 'Path. Trans.' vol. xxi. p. 305.
[3] See 'Syst. of Surg.' 3rd ed. vol. i. p. 1081.

by flexing the thigh on the pelvis, the body being at the same time bent forwards. Then, if the raised edge of the patella be depressed, the bone will be disengaged, and the muscles will restore it to the natural position. The limb should be placed on a splint for two or three weeks.

Sometimes the patella is dislocated edgeways, either its outer or inner edge being buried between the condyles (usually the former, according to Malgaigne). The dislocation is the result of direct violence, and in some cases much difficulty has been found in reducing it, or it has actually remained irreducible, in consequence of some interlocking of the edge of the bone which is impacted in the intercondyloid notch.

In some cases the usual method of reduction will at once succeed. If not, chloroform should be given and the knee flexed, as in Mr. Flower's case.[1] The division of the ligamentum patellæ has even been resorted to unsuccessfully; and in cases of extreme difficulty it might be worth while to divide any fibres of this ligament, or of the capsule, which can be felt on the stretch; but if the bone be then irreducible, it would be better to leave it alone for a time, and if the joint is afterwards the seat of inflammation or of much pain, to remove it either by excision or amputation.

The term 'dislocation of the patella upwards' is applied to cases in which the ligamentum patellæ has been torn and the lateral attachments of the patella also so far lacerated as to permit of a considerable amount of displacement upwards. The hollow presented below the patella by the torn ligament and the exposure of the trochlear surface of the femur beneath the skin, mark the nature of the injury. The treatment is the same as for fracture of the patella. I once had the opportunity of watching a case for some time in which the patient obtained almost, if not quite, complete restoration of the functions of the limb.

Dislocation of semilunar cartilages.

The *semilunar cartilages* are apt to be partially dislocated from the head of the tibia by slight injuries, such as a stumble, or even by catching the toe in the bedclothes, when their attachments have been previously stretched by inflammation of the joint, and their own substance enlarged so as to increase their prominence. The symptoms are sudden and severe pain in the joint, which remains semiflexed and cannot be straightened, with some synovitis. It will be remarked that these symptoms closely resemble those of loose cartilage, and it seems certain that many of the cases described as dislocation of the semilunar cartilages were cases of loose cartilage, while in others the precise nature of the injury is doubtful; but in the well-marked cases in which the edge of the interarticular cartilage has been felt projecting, and the appropriate manipulations have at once restored the motion of the joint at the same time that they reduced the projection, there is no reason to doubt the diagnosis, and there are two dissected specimens on record.[2] The necessary manipulation consists in completely flexing the knee on the thigh, which can be done gradually, and then suddenly extending the limb fully. As this may be otherwise

[1] In this case the patella was twisted on its longitudinal axis, with its outer edge projecting forwards under the skin, and its inner edge buried between the condyles of the femur and the head of the tibia. The limb was extended, and all attempts at reduction by bending the knee, manipulating the patella, &c., produced great pain, and were unavailing till chloroform was given, when, on bending the knee, the bone directly slipped back into its place. 'Syst. of Surg.' 3rd. ed. vol. i. p. 1082.

[2] 'Fergusson, 'Pract. Surg.' 5th ed. p. 323. Sir W. Fergusson does not say which cartilage was dislocated. Godlee, in 'Path. Trans.' xxxi. 240. In this case it was the external semilunar cartilage which was dislocated.

impossible, Mr. S. Smith of Leeds [1] recommends that a few feints be first made by extending only to a right angle, and then, when the patient is off his guard, performing the complete extension. If this plan does not succeed, the limb may be bent (under anæsthesia, if thought desirable), and an assistant having placed his arm in the popliteal space, to serve as a fulcrum, the tibia may be drawn downwards as far as possible and rotated slightly. At the same time pressure may be made on the projecting edge of the cartilage with the thumbs. If the reduction is successful, the patient, who could not move his limb before, can at once walk naturally.

Dislocation of the upper tibio-fibular joint.

Dislocation of the head of the fibula is illustrated by Boyer's case,[2] in which the whole bone was driven upwards and dislocated at the upper tibio-fibular joint in a case of dislocation of the ankle. Generally, however, this dislocation is a consequence of relaxation of the ligaments. If met with as a substantive injury the biceps is to be relaxed by bending the knee, and the displaced bone forced downwards. A compress is then to be firmly adapted to the head of the bone and retained there by strapping, while the knee is to be placed on a splint for about three weeks.



FIG. 145. Pott's fracture; showing the projection of the internal malleolus, the displacement of the foot outwards, and the depression at the point of fracture of the fibula.

Dislocations of the ankle.

Dislocations of the *ankle* occur in four different directions. Arranged in the order of their frequency, these dislocations of the bones of the foot are outwards, inwards, backwards, and forwards. The only one which is at all common is the dislocation of the foot outwards, which, as being always accompanied by fracture of the fibula above the malleolus, is called *Pott's fracture*, after the surgeon who first accurately described the injury. The fibula is fractured usually about two inches above its lower end; the internal malleolus is prominent, the deltoid ligament being ruptured; the astragalus is separated from the tibia, and the sole of the foot everted. Very frequently, however (in fact, I think usually), the malleolus of the tibia is fractured

Pott's fracture.



FIG. 146. The skeleton of the foot and leg in a case of Pott's fracture in which the internal malleolus is not injured. After Firrie.

[1] In an interesting paper entitled 'On Internal Derangement of the Knee-joint,' 'Lancet,' Sept. 20, 1851.

[2] 'Mal. Chir.' vol. iii. p. 883.

instead of the ligament being ruptured, so that the injury does not correspond exactly to Pott's description. The cause of the accident is almost always a fall on the foot, in which it is twisted outwards. Reduction is usually easy, by grasping the foot and drawing it downwards (the gastrocnemius having been relaxed by bending the knee and extending the toes), and then manipulating it into position. If pain and involuntary action of the gastrocnemius oppose this manœuvre, an anæsthetic must be given.

Much has been written on the treatment of Pott's fracture. I confess that I have never seen a case which required any other treatment than an ordinary fracture of the leg does—i.e. either side-splints or pasteboard splints for about six weeks; or, if the swelling and inflammation of the joint are considerable, treatment with the part exposed in a fracture-box at first; but cases may occur in which there is some unusual difficulty in keeping the foot at right angles to the leg, and with the sole level (which is the main point in the treatment of this injury), and then it may be necessary to adopt one of the methods recommended by Pott or Dupuytren, for which see p. 295.

Dupuytren's fracture.

Somewhat resembling this injury is the combination of dislocation of the foot outwards with fracture, which is known as 'Dupuytren's fracture.' The foot is displaced outwards and upwards, the fibula is fractured, and the tibio-fibular ligament torn away, or else the tibia is split longitudinally and its fragment displaced along with the lower fragment of the fibula.[1]



Fig. 147. Dislocation of the foot inwards. After Pirrie.

Dislocation of ankle inwards.

The dislocation inwards is also often accompanied by fracture of the tibia and possibly of the fibula also. It is caused by a twist of the foot in the opposite direction, and requires merely the same treatment as fracture of the leg, after the parts have been carefully reduced, for which purpose anæsthesia may be necessary.

Dislocation of ankle backwards.

Dislocation of the foot backwards occurs occasionally as the consequence of a violent shock on the fore part of the foot, or a fall backwards with the foot in a hole, and, like other dislocations of the foot, is often complicated with fracture of the malleoli. The accident is easily recognised by the shortening of the dorsum of the foot and the relative positions of the leg and heel on the two sides. The toes are generally pointed downwards. Reduction is generally easy, but the tendo Achillis, according to Mr. Bryant, sometimes requires division before the parts can be kept in position.[2]

Dislocation of ankle forwards.

The opposite dislocation—that of the foot forward—is still more rare. The heel is, of course, shortened more or less as the dislocation is more or less complete. It is distinguished from fracture low down, with displacement, by the position of the malleoli, which would, of course, be carried away with the foot in fracture, and, therefore, retain their natural relation to the heel;

[1] 'Syst. of Surg.' 3rd ed. vol. i. p. 1092.

[2] Bryant's 'Surgery,' vol. ii. p. 350. Cock, in 'Guy's Hosp. Reports,' 1855.

while in dislocation they would be nearer to the heel than natural. Reduction has often been found impossible, but the section of the tendo Achillis has been known to facilitate it.[1]

As a complication of severe injuries the astragalus may be driven upwards between the tibia and fibula; but this can hardly occur without considerable fracture of both of these bones. Still a true dislocation upwards is spoken of by Fergusson and Bryant, and Mr. Morris[2] describes a case under Mr. De Morgan's care in which there seems to have been no evidence of fracture.

Compound dislocations.

When these dislocations are compound, amputation used to be considered necessary, till Sir A. Cooper showed that this was not always the case. It remains true, however, that it is very frequently the safest course, though in young healthy persons, where the vessels have escaped damage and there are no other serious complications, the limb and the joint may often be saved. Ankylosis will ensue, but the increased mobility of the transverse tarsal joint will in a great measure compensate for this. In other cases, where there is much comminution, the surgeon may remove the loosened portions of bone, or even excise the whole joint.[3] When the limb is to be saved the wound must be examined and cleansed, and then carefully closed with equable and gentle pressure. Suppuration should be watched for, and the matter evacuated as early as possible, and such general treatment adopted as the pain or fever indicates. Secondary amputation not unfrequently becomes necessary.



148. Partial dislocation of the astragalus forwards; the posterior part of the bone is still in contact with the articular surface of the tibia.

a. The rounded head of the astragalus, projecting on the dorsum of the foot about as far forward as the root of the great toe.

b. The external malleolus, which remains in position, and in front of which is seen the articular facet corresponding to it on the astragalus. — From a preparation in the Museum of St. George's Hospital. Ser. I. No. 212 a.

Dislocation of the astragalus.

Dislocation of the *astragalus*, by which is meant a dislocation of that bone, both from its articulation with the bones of the leg in the ankle-joint, and from those with the os calcis and scaphoid, in the tarsus, is a very severe and dangerous injury. It must not be confounded with that which forms the subject of the next section, viz. the dislocation of the bones of the foot from the astragalus, the *subastragaloid* dislocation, in which the ankle-joint is unaffected. The diagnosis rests upon the unnatural relation between the head or other projecting part of the displaced astragalus and either of the malleoli which may be perceptible. In the sub-astragaloid dislocation, though the head of the astragalus is unnaturally prominent, it retains its natural distance from the malleoli; but when the astragalus is itself dislocated, in whatever direction the dislocation may have been, this measurement is, of course, altered.

The directions in which the astragalus may be dislocated are forwards, backwards, and to either side, the latter being compound. The dislocation

[1] Poland, 'Guy's Hosp. Reports,' 1855. [2] 'Syst. of Surg.' 3rd ed. vol. i. p. 1094.

[3] See a successful case of primary excision of the ankle by Mr. H. Lee, in 'Med.-Chir. Trans.' vol. lvii. p. 137. Since the publication of that case Mr. Lee has performed another similar operation at St. George's Hospital.

forwards is the most common (Fig. 148). The head of the displaced bone forms a considerable prominence on the dorsum of the foot far in front of its normal position; one or other malleolus is usually buried in the foot; the movements of the ankle-joint are abolished. There may be a wound exposing the displaced bone, and in many cases a fracture co-exists with the dislocation, so that strictly only a portion of the bone is dislocated. The part which retains its natural connections is generally the articulating surface of the head.

In dislocation of the astragalus backwards the posterior edge of the bone presses on the tendo Achillis, the tibia is prominent in front, and the anterior part of the foot appears shortened.[1]

The lateral dislocations are complicated with laceration of the skin, and often with fracture of the malleolus, though instances are recorded in which the malleoli have been proved to be entire.

Version of the astragalus.

In dislocations described as forwards or backwards there is almost always some amount of twisting or rotation of the bone. And cases have been put on record in which without any absolute dislocation the astragalus is turned more or less completely on its own axis, whether horizontal or vertical. The latest of these cases is that related by Mr. Barwell in the 66th volume of the 'Med.-Chir. Trans.,' where the reader will find references to the few others on record. In Mr. Barwell's case there was also dislocation of the foot from the astragalus, and a wound exposing the bone, which was excised. In cases of mere version of the astragalus there may be much difficulty in forming a diagnosis; but if the nature of the displacement should be recognised, the surgeon's treatment will be regulated by the amount of concomitant injury. Where, as in Mr. Barwell's case, there is also dislocation of the foot, and the twisted bone is exposed by a wound, I cannot doubt that excision is indicated. In some less complicated cases it might be possible to preserve the bone, whether restored or no to its normal relations.

Simple dislocations of the astragalus ought to be reduced when that is possible. An anæsthetic is usually required, and the patient should be brought fully under its influence. If the entire bone has been driven forwards out of the ankle-joint, it is clear that the contraction of the muscles forming the tendo Achillis has to be overcome before the bones of the foot can be drawn away from the tibia and fibula. The first point, therefore, is to endeavour to effect this by bending the knee and exercising steady traction on the foot, and if this should fail and the tendon is felt firmly contracted, to divide it subcutaneously. If reduction is still impossible, careful search should be made for the anterior tibial tendon, which sometimes slips round the displaced head of the bone and prevents its reduction. If this or any other tendon can be felt on the stretch, it will be well to divide them. Finally, on the failure of all such efforts the case is to be left alone. Instances have occurred in which all has gone on well, union has taken place between the displaced astragalus and the parts around it, and the patient has recovered with a foot lamed, indeed, but quite useful. Usually, however, matters do not go on so kindly. Either suppuration sets in or else (with or without suppuration and diffuse inflammation) gangrene comes on. In the latter case amputation should be at once performed as low down as is consistent with dividing healthy parts. In cases of suppuration unaccompanied by gangrene, in healthy youthful subjects the bone should be excised, and even in those more advanced in life the same course is perfectly defensible. A free incision should be so made as to avoid

[1] B. Phillips, in 'Med. Gazette,' for 1834.

the anterior tibial artery, the bone should be denuded sufficiently to afford a firm grasp for the lion-forceps, by means of which it should be twisted out of its bed, any remaining attachments being divided, and care being taken to avoid the tendons, vessels, and nerves. Recovery is marvellously complete after this operation. I have seen patients who were able to walk almost if not quite as well and as far as before the injury.

In cases of compound dislocation the choice generally lies between excision and amputation, the surgeon being guided by the amount of concomitant injury, and by the state of health and age of the patient. There are even cases in which the injury to the surrounding parts is slight and the patient's condition exceptionally encouraging, where an attempt may be made to reduce the bone and procure its consolidation with the parts around—in which case, though the movements of the ankle will be abolished, the foot will be on the same level as the other. Such an attempt to save the bone could, however, only be justifiable in the most favourable conditions of age and health. As a general rule the removal of the displaced bone is indicated.

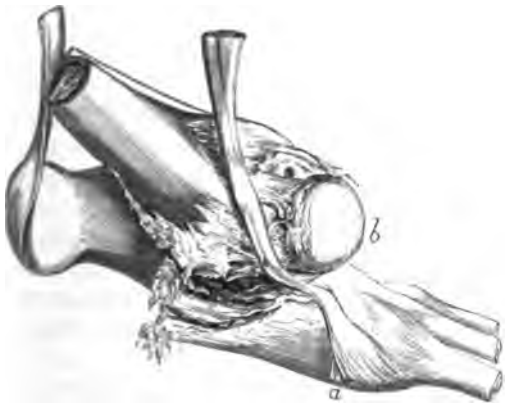


Fig. 149. Subastragaloid dislocation. Mr. Keate's case, described by Mr. Pollock in 'Med.-Chir. Trans.' vol. xlii. p. 40. *a*. Tendon of tibialis anticus. *b*. The head of the astragalus projecting beyond and internal to this tendon, which is lodged in the neck of the bone. The astragalus is still in its natural connection to the bones of the leg. Its posterior inferior extremity is pressed into the groove on the upper surface of the os calcis. There is no fracture except of the tip of the external malleolus, which still retains its ligamentous connection with the os calcis. The tendons are seen not to have been divided, and the dislocation remained unreduced. Amputation was afterwards required, but the patient died.—From a preparation in St. George's Hospital Museum. Ser. i. No. 212.

Subastragaloid dislocation.

The rest of the foot is sometimes dislocated from the lower surface of the astragalus, an injury which was at first confounded with the dislocation of the astragalus itself, and which certainly bears a good deal of resemblance to it, both in its symptoms and treatment; but as the anatomy of the injury is quite different, and there are some important points of difference in its surgical management, it is necessary to bear the difference in mind. A comparison of Figs. 148 and 149 will make it clear to the reader at once. In the former the astragalus has been driven in great part out of the box formed for it by the upper articulations of the ankle above, the joint surfaces of the calcaneum below, and that of the scaphoid in front. In the latter, on the other hand, the astragalus retains its connection with the bones of the leg, the ankle-joint is quite intact, and the injury affects only the astragalocalcanean and astragaloscaphoid joints. The other bones of the foot are, in fact, driven off from the lower surface and head of the astragalus. Hence the term '*subastragaloid dislocation*'—i.e. dislocation of the os calcis and scaphoid bones from the astragalus—which is now usually applied to the injury. The main diagnostic sign, as explained in the previous section, is that the distance between the head of the astragalus and the malleoli or malleolus is normal. This can always be ascertained; for though one malleolus may be buried in the soft parts, the other is thereby rendered prominent.[1]

[1] In a case quoted by Mr. Pollock, from Sir J. Paget's practice, it is said: 'There was

The foot is displaced usually inwards or outwards, the sole being everted in the former and the external malleolus buried, and *vice versâ* in the latter form of dislocation. In the dislocation of the foot outwards, the tibial tendons being displaced, one or other of them is apt to slide behind the head of the astragalus. In Fig. 149 it is the tendon of the tibialus anticus which thus embraces the neck of the bone; in other cases it has been that of the tibialis posticus, while a case is on record[1] in which reduction could not be effected until both these tendons had been divided.

Subastragaloid dislocation of the foot either backwards or forwards also takes place, the latter much more rarely, as it seems: or displacement anteriorly or posteriorly is combined with the lateral dislocation. This was so in the case which furnished Fig. 149—the bones of the foot being driven so far backwards that the projecting head of the astragalus rested on the cuneiform bones, and its calcanean facets on the cup-shaped articulating surface of the scaphoid.

The treatment of this injury will depend, in the first place, on the presence or absence of laceration of the skin, or of extreme contusion. If the injury be compound, most surgeons hold that amputation is necessary. There are, however, cases in which an attempt to preserve the part may be made, such cases being those in which the wound is a tolerably clean one, the soft parts little injured, and the patient young and in good health. In other cases, where the astragalus is much exposed, or somewhat injured, but the other conditions are favourable, it is right to excise the astragalus. But in the majority of compound dislocations the better course appears to be to remove the foot, which may be done either by Syme's or Pirogoff's method, or by the subastragaloid amputation, if the projecting bone be uninjured.

When the surgeon determines to reduce the dislocation, the patient should be thoroughly narcotised, the knee bent and the foot extended, so as to relax the gastrocnemius as much as possible, and attempts made to manipulate the parts into position. This will often succeed, especially when the foot is dislocated inwards or forwards. But if the tendo Achillis is much stretched, and all attempts at reduction increase its tension, it will become necessary to divide it subcutaneously, and then the dislocation inwards will probably yield to the manipulation. In the dislocation outwards the tibial tendons should next be divided, if they can be felt on the stretch. There are, perhaps, cases in which these tendons may require division, and not the tendo Achillis. Finally, on the failure of these measures the case should be left to itself, the foot being lightly supported on a splint, and cold sedulously applied to ward off inflammation. On the first appearance or threatening of active inflammation excision of the astragalus should be performed, otherwise amputation may become necessary.

Dislocations of the tarsus, metatarsus, and phalanges.

Dislocation of any of the separate bones of the tarsus is an accident of doubtful occurrence. Such accidents have been described, but the correctness of the description is still uncertain, except that the internal cuneiform, it seems certain, is sometimes dislocated along with the first metatarsal bone.[2] Disloca-

no swelling about the foot or ankle, and the nature of the injury was as evident as it would have been in a skeleton. The astragalus was felt in its normal relation to the tibia and fibula.'

[1] Quoted by Mr. Pollock in 'Med.-Chir. Trans.' vol. xliii. p. 56.

[2] I would refer the reader to Mr. Morris's essay, where he will find a *résumé* of the recorded cases. Mr. Morris admits the reality of dislocation of the os calcis from the

tions of the metatarsus affect either single bones, two or more, or finally the whole metatarsus. Dr. R. W. Smith[1] has recorded two cases in which he found old dislocations of the metatarsus upwards, and has figured and minutely described the appearances both before and after dissection; and Dr. Hitzig has collected twenty-nine cases of various dislocations of the metatarsus, in sixteen of which the whole metatarsus was dislocated, viz. in eleven upwards, in one downwards, in three outwards, and in one inwards. Thus the dislocation upwards is seen to be by far the most common.[2] These injuries are usually caused, according to Professor Smith, by a fall or leap from a height, but may also be produced by a weight passing over the foot. The symptoms are obvious; the hinder part of the foot and the ankle are natural; in dislocations of single bones or of part of the metatarsus the toes are correspondingly shortened, and the projection of the displaced bones is quite perceptible; in the dislocation of the whole metatarsus the whole foot is shortened and the sole rendered convex instead of concave. If the injury is recent, extension and counter-extension under chloroform, with pressure on the displaced bones, will probably succeed in reducing it; but Hitzig wisely deprecates too violent attempts at reduction; and the accounts of several cases show that even if the dislocation be unreduced the foot in time becomes useful.

The toes are but rarely dislocated, and then it is almost always the first phalanx, and is always upwards. The great toe is most commonly the subject of this lesion, and when it is so the same difficulty may be experienced as in the thumb, and probably from the same cause. As the injury is often compound, there would be no hesitation in such a case in removing the head of the bone; but in simple dislocation, if there were much difficulty in reducing it, it would be better to leave it alone. Of the dislocation of the second row of phalanges Malgaigne could find only two examples, and in both the dislocation was compound and was reduced.

astragalus and cuboid bones, and also dislocation of the medio-tarsal joint, of which latter, indeed, he refers to a dissected specimen. 'Syst. of Surg.' 3rd ed. vol. i. pp. 1103 et sqq.

[1] 'On Fractures and Dislocations,' p. 224.

[2] 'Berlin. Klin. Wochenschrift.' See an abstract in 'New. Syd. Soc. Bienn. Retr.' 1865–6, p. 273. Three cases of dislocation of the fourth metatarsal bone on to the dorsal surface of the cuboid will be found in the 'Gaz. des Hôp.' Aug. 15, 1876.

CHAPTER XVI.

GUNSHOT WOUNDS.

I NEED hardly say that in a work of this size, intended mainly as an introduction to the practice of civil life, the subject of gunshot wounds cannot be treated at full. Readers who wish to have the whole subject placed before them by the hand of a master will consult Mr. Longmore's 'Treatise on Gunshot Injuries.'

Gunshot wounds are defined as wounds caused by missiles projected by the force of an explosion, and they are therefore sometimes divided into those which are *direct*, i.e. caused by a body which (like the bullet or the fragment of a gun which has burst) is projected by the force of the explosion itself; and *indirect*, i.e. caused by some body (such as a splinter or a fragment of a wall) which has been set in motion by the projectile.

Mode of union.

Gunshot wounds are lacerated and contused in the highest degree, and therefore are commonly followed by sloughing. Dr. Simon of Rostock has, however, recorded some instances of primary union after such injuries;[1] and this possibility of primary union has probably been increased by the introduction of the 'modern arms of precision,' which project their bullets at a greatly increased speed, so as to cut through the tissues more like a knife (a result to which the conical shape of the bullets also contributes), instead of tearing and contusing them, as the old bullets always did, since these latter rapidly lost their velocity as they traversed the tissues. But as respects the fatality of gunshot injuries any slight diminution in the tendency to sloughing in the track of the wound which may be occasioned by the use of rifled arms is far more than counterbalanced by the great increase of force acquired by the projectiles used in modern warfare. It is not only that their great speed enables them to pass through the body of one man after another when standing in a mass—a result to which their lower trajectory also much contributes, and therefore that they cause many more wounds in proportion to the number of bullets discharged—but also the wounds inflicted on each individual are more grave. For the old round bullets used to be constantly deflected by the edge of a bone, a tense fascia, a muscle suddenly starting into action, and thus the subjacent viscera often escaped, so that a ball might enter at the front of the chest and pass out at the back, and yet the track might be entirely outside of the ribs. No such obstacles avail to check or turn aside the course of the newly-invented rifle-balls; the bones are shattered, and their fragments are the source of complicated mischief; the viscera more rarely escape, and the bullet often passes through a limb thrown in front of the body into the trunk, or *vice versâ*. The old distinction also which used to be made between the wounds of entrance

[1] 'New Syd. Soc. Biennial Retrospect,' 1867–8, p. 325. 'Deutsche Klinik,' 1867, p. 261. Mr. Longmore, however, in his recent treatise (p. 71), says that he has never seen a gunshot wound, or any part of one, heal by first intention. On the other hand, Prof. Michel of Charleston, U.S., has published in the 'Charleston Medical Journal,' July 1875, the particulars of eight cases in which primary union occurred along the whole track of the wound. In four of these cases the wound was superficial; but in the other four it was deep, and in three of them led down to a fracture.

ably and fully discussed in Mr. Longmore's article in the 'System of Surgery;' and I think I cannot do better than quote his conclusions, as follows:[1]—

'1. Trephining with a view to prevent anticipated consequences of a gunshot injury of the head, and speculative trephining in general, are not justifiable operations. Thus, the fact of there being a fracture and the bone being depressed is not of itself a cause for trephining. The occurrence of symptoms of compression, of epileptiform convulsions, or of paralysis, shortly after a gunshot injury, does not justify the primary use of the trephine, when the local condition of injury is concealed from view and uncertain. Local treatment and general remedies should be employed in the first place, and should be persevered in for some days, or even for two or three weeks, unless special urgency arises, before trephining is employed.

'2. When there is clear evidence that fragments of bone have been forced down so as to penetrate the cerebral substance—not merely that they are, or appear to be, lying upon the dura mater—and when they cannot be removed by simpler means, the trephine should be used to assist in their extraction as early as practicable, whether symptoms of compression or irritation are, or are not, present. This applies equally to projectiles or other foreign substances which may have been partly forced into the brain substance and are within reach.

'3. When a patient has sustained a gunshot fracture of the cranium, although the evidence as to the nature of the injury may not be precise, if it may reasonably be inferred that the fracture has been accompanied with depression, or with penetration of the surface of the brain, and the existing symptoms of cerebral compression or irritation not only do not yield notwithstanding the continued employment of remedies, but rather show a tendency to become worse, or the symptoms become so severe that extinction of life seems to be threatened, trephining is justifiable under the hope that it may be the means of arresting or removing the source of local mischief, and so averting the threatened fatal consequences.

'4. Lastly, at a later period, after gunshot fracture of the cranium with or without distinct evidence of penetration of the dura mater or brain, if, after a considerable period of convalescence, grave signs of cerebral compression or irritation manifest themselves, and these become more and more intensified in spite of other methods of treatment, then the trephine should be employed in the hope of finding the source of compression or irritation localised and within reach of relief.

'5. In any case in which trephining is performed, especially in cases where the dura mater has not been previously exposed by the injury, the operation should be done with strictly antiseptic precautions if possible. The relative immunity from irritation, from suppuration, and the more rapid healing of wounds which have been inflicted in opening the cranium under antiseptic precautions when contrasted with others in which similar treatment has not been adopted, have been demonstrated very conclusively.'

Gunshot wounds of the spine are usually complicated with injury of other parts, and the mischief to the column and cord is extensive and probably fatal. Little can, therefore, be done in most cases. There are, however, instances of the impaction of a bullet in or near the laminæ in which much good has been done by cutting down and extracting it, so that in any case where there is reasonable ground for suspecting that the bullet has lodged in an accessible situation, it is justifiable to cut down and ascertain whether this is the case; Of the spine.

[1] 'Syst. of Surg.' 3rd ed. vol. i. p. 506.

sations were due to injury of the brachial plexus.[1] Hæmorrhage is not a prominent feature of gunshot wounds. The main vessels very often escape injury altogether, even in wounds directly leading down to their course, and when they are hit they are usually so contused and lacerated that they do not bleed. But to this there are of course many exceptions, and there is an impression (which has never been brought to proof) that death on a field of battle very frequently occurs from wounds of the large vessels of the thorax. When a limb is torn off, whether by cannon-shot or otherwise, the main artery is generally seen pulsating up to the point at which it has been torn, and often hanging beyond the surface of the wound, exactly in the same way as when it is drawn out of a stump and twisted. Mr. Longmore says that hæmorrhage, when it occurs, much aggravates the thirst which often torments men who are wounded in the heat of action.

Treatment. In the treatment of gunshot wounds the first thing is to get the patient as soon as possible into a place of security. If he is in a state of syncope it may be proper to give a little stimulant at once. Some extemporised support should be arranged for a fractured limb; wounded arteries should be compressed or tied, if they are exposed, or possibly a tourniquet may be adjusted. When all this is arranged he is to be removed to the place where the definite treatment is to be undertaken, and then a thorough examination is made, the object of that examination being '(1) a correct knowledge of the nature and extent of the wound, (2) removal of any foreign bodies which may have lodged, (3) adjustment of lacerated structures, and (4) application of the primary dressings' (Longmore). The examination is most easily made immediately after the injury, since then sensibility is numbed, and there is less swelling. The patient should if possible be put in the attitude in which he was when he received the wound, as this will often give valuable hints as to the possible course and place of lodgment of the ball; his clothes should be carefully inspected, in order to see whether any pieces have been carried in with the bullet, and the track should be attentively examined for fragments of the clothes, the bullet, splinters from it or from the bones, and any other foreign substance. No search, however, should be made in wounds penetrating the great cavities of the body. The skin is only to be divided when such division is necessary in order to extract bullets or fragments of shell (of which very large pieces sometimes pass in through a comparatively small wound), or to tie vessels or replace herniated viscera. The old plan of enlarging the orifices of gunshot wounds to obviate retention of matter is quite given up.

The detection of a bullet or lodged foreign body is by no means easy. Fragments of clothes can hardly be detected by any other means than the finger; but very important questions sometimes occur (as in the celebrated



FIG. 150. Nélaton's probe. The bulb at the end is of white china.

case of Garibaldi) with reference to the detection of bullets. It is for such cases as these that the various instruments enumerated by Mr. Longmore[2] have been invented: Nélaton's test-probe, in which a small nob of biscuit china is prepared for taking an impression of lead or rust, on being rubbed against a leaden or iron projectile; Lecompte's 'stilet-pince,' in which an

[1] 'Syst. of Surg.' 3rd ed. vol. i. p. 474.
[2] Ibid. p. 481. Gunshot Injuries, Sect. VIII. ch. v.

juries of civil life, and that the fragments may wound vessels or be driven into the lung even when the bullet itself has not penetrated. And it should also be remembered that without penetration, and even without any fracture of the ribs, the lung may be more or less bruised or lacerated.

Diagnosis of wound of the lung.

In penetrating wounds the chief point is to decide whether or no the lung has been injured. The symptoms of injury of the lung are shock, hæmorrhage from the wound, hæmothorax, hæmoptysis, dyspnœa, traumatopnœa, and emphysema. These symptoms are of different value in proving the point, and any of them may be present in cases where the lung is not wounded, and absent in cases where it is, so that it may be said that there is no one symptom which is absolutely pathognomonic. Yet the presence of all of them, or of the great majority, or of the leading symptoms in a very high degree, renders it extremely probable that the lung is wounded, and justifies the surgeon in that diagnosis.

Shock in wound of the lung.

Shock is a very variable symptom. It is frequently present to a great extent in cases where no serious mischief has been done, and it has been often found absent where the lungs have been perforated. Its presence could, therefore, only strengthen a diagnosis which has been formed upon more reliable symptoms.

External hæmorrhage in wound of the lung.

Hæmorrhage from the wound, if abundant, and if there is no large vessel near in the parietes (and there is rarely any such vessel), must come either from the lung or from an intercostal or internal mammary artery within the chest. The direction of the wound and the result of introducing a small spatula or piece of card (if it can be done without risk) into the inside of the parietes will enable the surgeon to form an opinion as to which of these two is the source of the bleeding. Still, by itself, external hæmorrhage is only one of the minor diagnostic symptoms of wounded lung.

Hæmothorax.

Hæmothorax, if considerable, usually comes either from the substance or the root of the lung—in the latter case it is almost certainly fatal, and in the former very often is so. Still a good deal of blood may pass into the pleura from a wound of the intercostal arteries without wound of the lung, so that hæmothorax also is not an infallible symptom.

Hæmoptysis.

Hæmoptysis may occur from mere bruising of the lung without any absolute penetration, and therefore does not by itself prove even that the wound has opened the chest. But if hæmoptysis is very copious it renders it very probable that the lung has been wounded; and this is converted almost into a certainty if the blood is churned up together with air into an abundant pink froth, and especially if a similar pink froth escapes from the wound.

Dyspnœa.

Dyspnœa is a very variable sign, and depends in a great measure on the patient's previous condition and other circumstances which it is hardly possible to enumerate; and it is often present in mere wounds of the parietes.

Traumatopnœa.

Traumatopnœa, or the passage of air out of the wound, is possible without any wound of the lung; for the pleura having been laid open the air may pass in through the wound as the parietes recede from the lung in inspiration, and then be forced out again as they descend in expiration. It is, however, a symptom which must always excite the surgeon's suspicion; and it proves, at any rate, that the wound is a penetrating one.

Emphysema.

Emphysema is rare in any case, since the wound usually allows the air to pass freely out of it, but otherwise the same observations apply to it as to traumatopnœa.

Treatment of wounds of the lung.

From this it will be seen that it is usually possible to form a diagnosis which, if not mathematically certain, yet is practically sufficiently accurate to

nearer the ball has gone to the known course of a large vessel. It may sometimes be advisable under such circumstances to leave a tourniquet loosely applied, in charge of the attendant, with instructions to screw it down if the vessel should begin to bleed. If hæmorrhage occurs, no time should be lost in cutting down on the artery and tying it above and below, if the state of the part admits. Should it be impossible to find the artery, or should it be so disorganised as not to bear a ligature, the choice lies between compression in the wound, tying the trunk artery above, and amputation. The surgeon would incline to the first alternative in all ordinary circumstances; but if local pressure carefully made has failed, and if the hæmorrhage is urgent, the second alternative, that of tying the main artery at a higher point, may be adopted in the upper extremity in almost all circumstances, and in the lower where gangrene does not seem imminent. In other cases it would be better to remove the limb.

Gunshot wounds in each region of the body.

A few points must be noticed in the surgery of gunshot wounds in each region of the body in which their prognosis, diagnosis, or treatment differs in some respects from that of the ordinary injuries of civil life.

Of the head.

Gunshot wounds of the head are always to be looked on with grave apprehension. Even simple contusions may be accompanied by fatal injury to the brain, and many histories are on record showing the rapidly fatal result of drinking or excitement after injuries which had not been known to involve any deeper mischief than a mere bruise or a small contused wound on the head. Such is the case quoted by Longmore, from the surgical history of the Crimean campaign, of a man who was sent home from the Crimea after a superficial wound of the head, and in whom, after a drinking bout, coma supervened, and he died shortly afterwards. 'Post-mortem examination showed traces of inflammatory action in the dura mater, and just anterior and superior to the corpora quadrigemina was a tumour the size of a walnut, composed of organised fibrine and some clotted blood.' In this case the existence of some mischief was suspected in consequence of persistent headache, on account of which the man was invalided; but a similar result has been known to take place without any symptom having been observed. The same liability to remote and unapparent injury of the brain and other parts renders all gunshot wounds of the skull more serious than similar injuries are in civil life. Thus fracture or fissure may extend beyond the part struck, or the internal table may be fissured and driven in with little or no apparent injury to the external, or the meningeal vessels or the brain itself may be lacerated. Fractures with depression are usually fatal unless the depression is very slight, since the brain is generally injured. And penetrating wounds of the brain are still more certainly fatal. Out of eighty-six cases recorded in the history of the Crimean war none survived. Nevertheless there are instances of recovery in which either the ball has passed out again or has become encysted in the brain, though in the latter instance it may set up secondary inflammation at any subsequent period.

The treatment is to be conducted on the same general rules as in other injuries of the head. In men previously in strong health both the general and local treatment should be strictly antiphlogistic. Venæsection is of the greatest service in such cases, and the constant application of cold to the head, strict rest in a darkened room, and low diet, are also undeniably requisite. Trephining should, as a general rule, be avoided; at least this seems the opinion of the most experienced military surgeons.

The reader will find the subject of trephining in injuries of the head most

ably and fully discussed in Mr. Longmore's article in the 'System of Surgery;' and I think I cannot do better than quote his conclusions, as follows:[1]—

'1. Trephining with a view to prevent anticipated consequences of a gunshot injury of the head, and speculative trephining in general, are not justifiable operations. Thus, the fact of there being a fracture and the bone being depressed is not of itself a cause for trephining. The occurrence of symptoms of compression, of epileptiform convulsions, or of paralysis, shortly after a gunshot injury, does not justify the primary use of the trephine, when the local condition of injury is concealed from view and uncertain. Local treatment and general remedies should be employed in the first place, and should be persevered in for some days, or even for two or three weeks, unless special urgency arises, before trephining is employed.

'2. When there is clear evidence that fragments of bone have been forced down so as to penetrate the cerebral substance—not merely that they are, or appear to be, lying upon the dura mater—and when they cannot be removed by simpler means, the trephine should be used to assist in their extraction as early as practicable, whether symptoms of compression or irritation are, or are not, present. This applies equally to projectiles or other foreign substances which may have been partly forced into the brain substance and are within reach.

'3. When a patient has sustained a gunshot fracture of the cranium, although the evidence as to the nature of the injury may not be precise, if it may reasonably be inferred that the fracture has been accompanied with depression, or with penetration of the surface of the brain, and the existing symptoms of cerebral compression or irritation not only do not yield notwithstanding the continued employment of remedies, but rather show a tendency to become worse, or the symptoms become so severe that extinction of life seems to be threatened, trephining is justifiable under the hope that it may be the means of arresting or removing the source of local mischief, and so averting the threatened fatal consequences.

'4. Lastly, at a later period, after gunshot fracture of the cranium with or without distinct evidence of penetration of the dura mater or brain, if, after a considerable period of convalescence, grave signs of cerebral compression or irritation manifest themselves, and these become more and more intensified in spite of other methods of treatment, then the trephine should be employed in the hope of finding the source of compression or irritation localised and within reach of relief.

'5. In any case in which trephining is performed, especially in cases where the dura mater has not been previously exposed by the injury, the operation should be done with strictly antiseptic precautions if possible. The relative immunity from irritation, from suppuration, and the more rapid healing of wounds which have been inflicted in opening the cranium under antiseptic precautions when contrasted with others in which similar treatment has not been adopted, have been demonstrated very conclusively.'

Gunshot wounds of the spine are usually complicated with injury of other parts, and the mischief to the column and cord is extensive and probably fatal. Little can, therefore, be done in most cases. There are, however, instances of the impaction of a bullet in or near the laminæ in which much good has been done by cutting down and extracting it, so that in any case where there is reasonable ground for suspecting that the bullet has lodged in an accessible situation, it is justifiable to cut down and ascertain whether this is the case; Of the spine.

[1] 'Syst. of Surg.' 3rd ed. vol. i. p. 506.

and if the bullet can be felt impacted near the spinous process or laminæ its extraction should undoubtedly be attempted. (See Longmore, op. cit. p. 509.)

A case occurred some years ago in London in which Mr. Canton succeeded in removing a bullet which was lodged in the upper part of the spinal column, and the patient recovered.[1] The case which occurred in Dublin some years since is also well known, in which Mr. W. Stokes made an attempt to extract a bullet which was lodged in the atlas.[2] The man died, and the treatment was blamed, but most unjustly, as there is no doubt that such an attempt should be made whenever there are no special counter-indications.

Of the face.

Gunshot wounds of the face are more distressing and horrible than dangerous, that is, if they are limited to the face. Large parts of the features may be shot away and yet the patient survive. But they are liable to be complicated with injury to the skull, pharynx, larynx, or large vessels, which may easily cause death; and there are often very distressing though not fatal consequences from lesions of the eyes or of nerves, ducts, &c. These wounds are also peculiarly liable to secondary hæmorrhage. It is to be noted, however, that much may be done in the way of saving deformity by replacing parts, even if the whole of the part replaced may not preserve its vitality, so that an anæsthetic should be administered, the torn parts replaced, trimmed up if they are lacerated beyond all hope of union, and sewn together as neatly as is possible.

Of the neck.

In gunshot wounds of the neck the large vessels often escape injury, otherwise the case terminates fatally at once. When the œsophagus is injured nothing can be done beyond supporting the patient with nutrient enemata, and when this is no longer possible endeavouring to convey food into the stomach through the wound till the latter has contracted sufficiently to allow a tube to be passed from the mouth. In wounds of the trachea the opportunity of performing tracheotomy below the wound is sometimes, though rarely, obtained. If, however, the trachea is wounded, but there are no indications of portions of cartilage or foreign bodies being in the trachea, and the patient breathes easily, it is better to let him alone.

The great nerves at the root of the neck may be wounded or contused—and I have already alluded to a case of wound of the brachial plexus—but little can be done in the way of treatment. The reader is referred to the section on Injuries of Nerves.

Of the chest.

Gunshot wounds of the chest are divided into penetrating and non-penetrating, the latter being those in which the serous membranes (pleuræ or pericardium) are not opened, and the former where they are. Again, in penetrating wounds the contained viscera may be injured or may not. Non-penetrating wounds present few peculiarities. It may be noted that when the ribs are fractured such fractures are more comminuted than in the in-

[1] The 'Lancet,' July 1861. In this case (the details of which are of a most interesting nature) the bullet had been fired from a very short distance, and struck against the spinous process, or some part of the arch, of one of the highest cervical vertebræ. The wounded man felt a momentary shock, and thought himself paralysed; but, on being again shot by his assailant in the face, and losing a good deal of blood, his powers of motion returned, and that to so vigorous a degree that he was able to carry out successfully a dreadful and protracted struggle for his life, which ended in the death of his assailant, from repeated blows on the head. A portion of bone exfoliated from the injured vertebræ; but the man recovered completely.

[2] 'Brit. Med. Journ.' 1871, vol. ii. p. 716.

juries of civil life, and that the fragments may wound vessels or be driven into the lung even when the bullet itself has not penetrated. And it should also be remembered that without penetration, and even without any fracture of the ribs, the lung may be more or less bruised or lacerated.

Diagnosis of wound of the lung.

In penetrating wounds the chief point is to decide whether or no the lung has been injured. The symptoms of injury of the lung are shock, hæmorrhage from the wound, hæmothorax, hæmoptysis, dyspnœa, traumatopnœa, and emphysema. These symptoms are of different value in proving the point, and any of them may be present in cases where the lung is not wounded, and absent in cases where it is, so that it may be said that there is no one symptom which is absolutely pathognomonic. Yet the presence of all of them, or of the great majority, or of the leading symptoms in a very high degree, renders it extremely probable that the lung is wounded, and justifies the surgeon in that diagnosis.

Shock in wound of the lung.

Shock is a very variable symptom. It is frequently present to a great extent in cases where no serious mischief has been done, and it has been often found absent where the lungs have been perforated. Its presence could, therefore, only strengthen a diagnosis which has been formed upon more reliable symptoms.

External hæmorrhage in wound of the lung.

Hæmorrhage from the wound, if abundant, and if there is no large vessel near in the parietes (and there is rarely any such vessel), must come either from the lung or from an intercostal or internal mammary artery within the chest. The direction of the wound and the result of introducing a small spatula or piece of card (if it can be done without risk) into the inside of the parietes will enable the surgeon to form an opinion as to which of these two is the source of the bleeding. Still, by itself, external hæmorrhage is only one of the minor diagnostic symptoms of wounded lung.

Hæmothorax.

Hæmothorax, if considerable, usually comes either from the substance or the root of the lung—in the latter case it is almost certainly fatal, and in the former very often is so. Still a good deal of blood may pass into the pleura from a wound of the intercostal arteries without wound of the lung, so that hæmothorax also is not an infallible symptom.

Hæmoptysis.

Hæmoptysis may occur from mere bruising of the lung without any absolute penetration, and therefore does not by itself prove even that the wound has opened the chest. But if hæmoptysis is very copious it renders it very probable that the lung has been wounded; and this is converted almost into a certainty if the blood is churned up together with air into an abundant pink froth, and especially if a similar pink froth escapes from the wound.

Dyspnœa.

Dyspnœa is a very variable sign, and depends in a great measure on the patient's previous condition and other circumstances which it is hardly possible to enumerate; and it is often present in mere wounds of the parietes.

Traumatopnœa.

Traumatopnœa, or the passage of air out of the wound, is possible without any wound of the lung; for the pleura having been laid open the air may pass in through the wound as the parietes recede from the lung in inspiration, and then be forced out again as they descend in expiration. It is, however, a symptom which must always excite the surgeon's suspicion; and it proves, at any rate, that the wound is a penetrating one.

Emphysema.

Emphysema is rare in any case, since the wound usually allows the air to pass freely out of it, but otherwise the same observations apply to it as to traumatopnœa.

Treatment of wounds of the lung.

From this it will be seen that it is usually possible to form a diagnosis which, if not mathematically certain, yet is practically sufficiently accurate to

justify prognosis and treatment. As to the former, the injury is a very dangerous but not an absolutely hopeless one, the dangers being primarily from hæmorrhage and consequent exhaustion or asphyxia, and secondarily from inflammation. It is, therefore, to the avoidance of these dangers as far as possible that treatment is to be directed. In the first place, collapse, if not so profound as to threaten to prove fatal, should not be interfered with, as it tends to check bleeding and gives time for clots to form. Any vessels which may be accessible must be tied. Strict quiet must be enforced. The application of cold externally may be useful. Opium should be administered in full doses, and internal styptics (such as gallic acid and acetate of lead), though little to be relied upon, may possibly be of service. If the patient is strong enough he may be bled to syncope from a large opening in the vein ('pleno rivo'). No probing or meddlesome searching of the wound is in the least degree justifiable, but foreign bodies which are accessible must be carefully removed, and the finger may be cautiously inserted into the wound to replace depressed or comminuted fragments of bone, when there is good reason to believe it necessary. The patient should be put in such a position as is easy to him and will not favour the gravitation of fluid into the pleura; so that he is usually placed on or inclining to the injured side; and the wound is to be lightly dressed. The practice of sealing the wound with a view of repressing hæmorrhage has not proved successful. If blood accumulates in the pleura it must be removed, either by incision or by tapping.

Subsequently, when symptoms of pleuro-pneumonia come on, the main questions of treatment are as to the administration of antimony and as to venæsection. Antimony often affords great relief in wounds of the chest when the patient is strong and florid, and when he finds a difficulty in expectorating the fluid which passes into the bronchial tubes. If given it should be in small but frequent doses (viz. ℥ v. : x. of the Vinum Ant. every three hours).

The use of bleeding in gunshot wounds of the lung was no doubt carried to excess by Guthrie and the older surgeons, yet there can also be no doubt that it often affords the greatest relief and benefit in these as in other injuries of the chest. It may be used, as above stated, primarily in order to induce artificial collapse, though this is rarely done in the present day, since it is believed that the weakness so produced renders the patient less able to bear the subsequent inflammation. At a subsequent period venæsection to a moderate amount is indicated when the dyspnœa is in excess of the shock; that is to say, when the patient is suffering much from oppression, with congested face and lips, and the pulse is firm (still more when it is hard), he will derive great and immediate relief from losing about 10 oz. of blood, and in all probability will be well able to bear one or even more repetitions of the bleeding. But when the face is pale and the pulse small, bleeding will probably only hasten his death.

Gunshot wounds of the heart do not differ from other wounds of the same organ, except in their even more certain fatality.

Of the abdomen.

Wounds of the abdomen, like those of the chest, are divided into non-penetrating and penetrating. Of non-penetrating wounds nothing need be said here. In penetrating wounds the viscera are usually injured, and some collapse is generally present. The diagnosis of the exact nature of the injury is not always easy, and indeed it may be of a very complicated character, the bullet having passed through several viscera, or many coils of intestine, besides having wounded vessels or bones in its course. The diagnosis of the viscus injured must be made from the same symptoms as in other wounds, e.g. the

hæmatemesis and pain in taking food which accompanies wounds of the stomach, the escape of fæcal matter or gas in injuries of the intestines, &c. Penetrating wounds of the abdomen are not always fatal; recovery with or without fæcal fistula sometimes ensues. In shell-wounds or other large lacerations the viscera may protrude, either uninjured or wounded. In the former case their prompt reduction is necessary. If wounded intestine protrudes the surgeon must decide, from a careful examination of the extent and nature of the wound, whether it can be sewn up and returned with any prospect of success, or whether it is necessary to attach it to the wound and make an artificial anus. In wounds where the intestine is opened, but does not protrude, it has lately been proposed to cut down on the seat of injury by enlarging the wound, remove the bullet or any foreign substance, and deal with the wounded intestine according to circumstances. This suggestion has not, as far as I know, been acted on hitherto; and it seems to me to hold out little prospect of success, especially in the conditions usually met with in warfare; but I must refer the reader to Mr. Longmore's essay (p. 536), for the further discussion of the topic. Protrusion of the solid viscera with wound hardly occurs except in injuries which are necessarily fatal.

The diaphragm may be perforated by a wound, and phrenic hernia may be thus caused, or the bullet may lodge in the pleura, in which it may roll about loose. Mr. Guthrie was in the habit of teaching that in such cases the proper course was to cut into the pleural cavity in the last intercostal space and extract the ball;[1] but no case in which that operation has been performed is as yet on record, except where the bullet has been felt; nor does it seem that the diagnosis is quite so certain as would be required for so grave an undertaking. In some cases the irritation of the foreign body lying on the diaphragm has led to constant and spasmodic cough, but in others no such sign of the presence of the bullet has been observed,[2] and I think no one would now consider himself justified in cutting down in search of a bullet in the pleural cavity unless he had felt it.

Wounds of the hypogastrium, perinæum, and genital organs.

A perforating wound in the hypogastrium may involve the bladder. The bladder may be reached either from above the pubes, through the peritonæum, or below the reflection of that membrane or through the perinæum. It may even be reached in the female through the vagina[3] without any serious injury to the soft parts, and it would be possible that it should be wounded in the male from the rectum,[4] though in such a case the perinæum or ischiorectal fossa must be also injured. If the ball, or a portion of the clothes, should remain in the bladder, the usual symptoms of foreign body or stone will follow, and the usual operation has often been performed with success.[5] A wound of the bladder through the peritonæum will, in all probability, prove fatal; but recovery has often been recorded in wounds which were therefore assumed not

[1] Guthrie's 'Commentaries,' 1855, pp. 491–497.

[2] See the case of Thain, related by Mr. Poland in 'Syst. of Surg.' vol. i. p. 835, 3rd ed.

[3] Emmet, on 'Vesicovaginal Fistula,' p. 221.

[4] There is a striking case described by Sir Prescott Hewett in the 'Path. Trans.' vol. i. p. 152, and of which a preparation is preserved in the Museum of St. George's Hospital, Ser. ix. No. 35, of wound of the bladder through the rectum by the broken upright of a chair, on which the patient fell. There is no reason why a bullet should not pass in the same direction, though I am not able to refer to a recorded case.

[5] Mr. Dixon gave, in the 23rd vol. of the 'Med.-Chir. Trans.' references to fifteen cases in which this operation had been performed, and with success in a very large proportion of them. He also mentions one in which a small bullet which had passed into the bladder was voided by the urethra.

to have implicated that membrane. The use of the catheter in penetrating wounds of the bladder is generally indicated, unless the external wound is free enough to provide complete exit for the urine. Whether the catheter should be left in or no will depend on circumstances, such as the ease or difficulty of its introduction, and the irritation which it causes; but it must, at any rate, be used often enough to prevent any distension of the bladder, unless the patient can pass water himself, which is rarely the case. If any foreign body is felt in the bladder its immediate extraction is imperative.

Wounds of the penis, scrotum, and testicles are rare as uncomplicated injuries, and those of the external parts in the female almost unknown. Their treatment involves no special points.

Of the extremities.

Gunshot wounds of the extremities need only be noticed here when complicated with lesions of bone, or presenting some other peculiarity. The

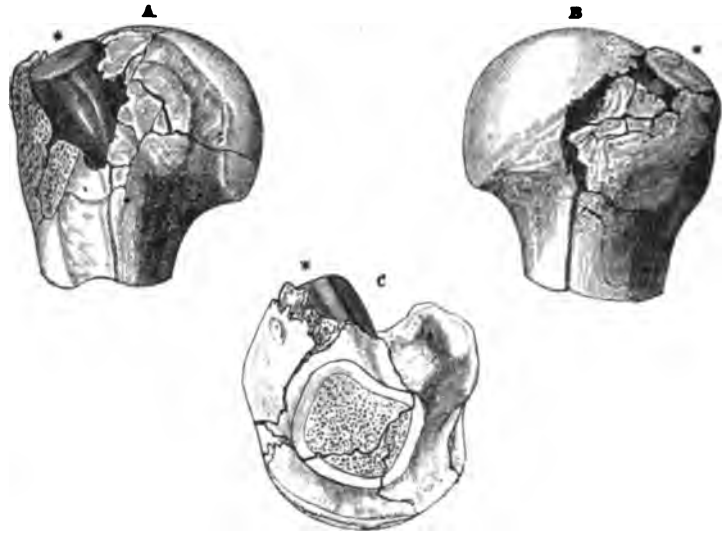


FIG. 152. Injury of the head of the humerus by a *conoidal* bullet. The bullet (shown by the asterisk*) has entered apex first, and is imbedded in the cancellous tissue, its base being on a level with the surface of the bone. Great splintering has followed. A and B show the condition of the head, and C the fissured state of the shaft at the part where the operation of resection has been performed. It is probable that these fissures extended some distance in the shaft below the line of resection.

general rules of surgery are only modified in these injuries by the extensive splintering of the bone which bullets, and especially the conical bullets, cause, and the osteomyelitis which is so likely to follow,[1] by the consequences of the sloughing which almost always follows gunshot wounds, and by the circumstances under which the great majority of these injuries are treated. All these peculiarities are very unfavourable for the success of excision, in comparison with amputation, in the lower extremity. For the success of excision of the hip and the knee it seems essential that the bone exposed should be uninjured, the soft parts predisposed to healthy action, and, above all, that the

[1] Figs. 152, 153, are interesting examples of the great splintering and extensive injury which conoidal bullets inflict on the bones, as contrasted with the more limited effects of round bullets. They also show conditions of the articulating end appropriate for excision, at least in the upper extremity. It seems doubtful whether excision of the knee could be practised successfully if the bone were splintered as in Fig. 152; but it might be ventured on if a bullet were lodged in the head of the tibia or in the femur, and the bone were not splintered, as in Fig. 153.

patient should be left undisturbed for a long period. None of these things are so essential in excision of the shoulder or elbow. Accordingly, we find that the two latter operations were brought into general acceptance mainly in consequence of their success in warfare,[1] while the excisions of the hip and knee, although they have sometimes succeeded in war, can count very few successes either in these or in any other primary injuries. This well-known fact makes a great distinction in the surgery of gunshot injuries in the upper and lower extremities.

The following are, I believe, the main maxims of practice in gunshot injuries of the extremities:[2]—

I. *In the upper extremity.*—If the lesion of the soft parts does not seem too extensive do not amputate. Do not perform any formal excision unless the shoulder or elbow is opened, but remove loose fragments of bone, provide free exit for discharges, and put the parts in a favourable position for union. In



Fig. 153. A and B show the head of a humerus which has been struck by a *round* ball in nearly the identical spot at which the specimen represented in Fig. 152 has been struck. The round ball, like the conoidal, has also entered to a distance corresponding with its own depth, its surface being on a level with that of the surrounding bone. Although the head of the bone has been greatly shattered, as shown in A, the rending asunder, or splintering, is very limited; and the saw, in resecting the injured head, has passed through the shaft (see C) without crossing a single fissure, and this notwithstanding the operation has been performed somewhat nearer to the neck of the bone than in the preceding instance. The figures represent two preparations, Nos. 2,926 B and 2,926 D, in the Museum of the Royal College of Surgeons, and are taken from 'Syst. of Surg.' 3rd ed. vol. i. p. 467.

injuries of the shoulder and elbow, however, the patient has a better chance of a useful limb if the usual amount of bone be removed by excision; and the extension of fissures into the shaft of the humerus, or into the bones of the forearm, does not greatly prejudice the chances of the patient's recovery, though in the case of the shoulder the frequency of injuries to the scapula or axillary vessels and nerves is certainly a formidable complication. When, however, along with grave injuries to the soft parts, or with comminuted fracture,

[1] The success of Baron Larrey in excising the shoulder in the wars of the Republic and Empire was one of the first causes of the reception of that operation; while the success of Esmarch in excising the elbow in the war in Schleswig-Holstein, though less striking from accidental circumstances, and although the operation was already a received one, did much to propagate and extend its use.

[2] It is assumed that the usual rules of practice have been carried out, and foreign bodies if possible removed.

the main vessels or nerves or both are wounded, it is usually more prudent to amputate. Yet even in some cases of wound of the main artery in the upper extremity complicated with fracture, if free from other complications, and in a young and healthy subject, the attempt to save the limb may be made.

II. *In the lower extremity* gunshot fractures involving the hip-joint or the upper third of the femur are usually fatal, however treated. Primary amputation is so fatal in these cases that it is almost abandoned. Several cases have recovered under strictly conservative treatment; a few cases of successful excision are on record; and secondary amputation has been decidedly more successful than primary. The surgeon must use his own discretion in each case, but all surgeons nowadays have a well-founded horror of primary amputation at the hip, believing that the operation is almost necessarily fatal, while the injury is not so.[1]

In gunshot fracture of the lower part of the femur amputation is the rule. Cases have also been treated, when free from any other complications, on the conservative method, all comminuted portions being removed, and the parts put up in the best apparatus which circumstances permitted the surgeon to make; but it seems the opinion of the most experienced military surgeons, that in the general run of cases amputation is the best course, though in special instances the attempt to save the limb may justifiably be made.

When a bullet lodges in the knee-joint, or passes through the joint splintering the bones yet not producing any further discoverable lesion, excision may be resorted to. But hitherto it must be admitted that the attempt has led to disappointment, or in plainer terms to loss of life,[2] and that amputation is a far safer practice. In the rare cases of such accidents occurring in civil life at an early age, and with all the necessary appliances for undisturbed treatment, it may be justifiable (though it is certainly rather doubtful practice) to risk excision; but in common military practice no doubt can be entertained that until we possess some more successful method of practising excision the

[1] Mr. Longmore thus sums up the experience of military surgery hitherto in respect to amputation at the hip. 'During the late war in the United States there occurred 62 authenticated hip-joint amputations, 40 in the United States' armies, and 22 in the Confederate armies. These have been divided in the history given of them into four categories: primary operations, on the field itself or within 24 hours of the wound; intermediate, from 1 to 28 days after; secondary, at various dates, but all subsequent to 28 days; and re-amputations, or cases in which there had been a previous amputation farther away from the trunk. Dr. Otis has collected from all other sources 121 recorded instances of amputation at the hip-joint for gunshot injuries, making, with the 62 American cases, a total of 183 operations, being all that were known of up to 1869. Of this number, 79 were primary operations, with only 1 recovery, or a mortality of 98·68 per cent.; 76 intermediate, with 6 recoveries, a mortality of 92·10 per cent.; 20 secondary, with 7 recoveries, a mortality of 65 per cent.; and 8 were re-amputations, with 4 recoveries, a mortality of 50 per cent. Regarding all the 183 hip-joint amputations together, with 18 recoveries, the mortality ratio is 90·9 per cent. The accumulated experience thus gained indicates that this formidable operation should be confined to cases which are entirely hopeless without it, to injuries in which the damage done by the shot is not confined to the joint or upper part of the femur in which resection could be employed, but is accompanied with laceration of the femoral vessels or other injuries to the extremity of so extensive and serious a nature as to leave no other surgical resource available. It also confirms the conclusion which had generally been arrived at before the United States' war: that as a secondary operation, for the results of inflammatory necrosis after gunshot injuries or after previous amputations in the shaft, the risk is less than it is in the cases where it is performed as a primary amputation. 'Syst. of Surg.' 3rd ed. vol. i. p. 559.

[2] In the American Surgeon-General's report it is stated that out of eleven resections of the knee all but two terminated fatally, and a doubt is expressed of the reality of recovery in one of the remaining two.

surgeon's duty is to amputate. There are, however, cases in which the surgeon may very reasonably attempt the entire preservation of the limb, giving exit to matter and loose fragments as they present. Langenbeck believes, and I have no doubt with good reason, that the success of such attempts would be much favoured by putting up the limb at once in a well-fitting case of plaster of Paris.

In gunshot injuries of the leg the limb may often be saved, and in many of these cases the resection of the comminuted bones, and possibly of the portion of the shaft around them, may be advisable. The same observations apply to those injuries in which the ankle has been laid open. In such cases the removal of comminuted portions of bone is often spoken of as an 'excision of the ankle,' and if the term be admitted the operation may be said to be a successful one. Langenbeck is the chief authority in recommending excision of the ankle in military surgery, having operated five times in the Schleswig-Holstein war of 1864, and eleven times in the Austro-Prussian war of 1866, with thirteen successes and three deaths. In all the cases the periosteum was preserved as far as possible, and the limb put up in a plaster-of-Paris splint at once. But the operation differs from the ordinary excision of the ankle for disease in this very important particular, that the bones of the foot are not diseased and are usually untouched, and that the patient, instead of being a sufferer from chronic disease, is usually healthy. The success of the excision of bones of the leg (called excision of the ankle) for gunshot injury, even if we allow that it has been real—i.e. that the same success could not have been obtained without operation—does not bear on the question of excision of the ankle for disease.

For wounds of the nerves of the limbs I must refer the reader to a subsequent chapter, in which the affections of nerves are treated.

CHAPTER XVII.

TUMOURS.

THERE are few parts of surgical pathology in which such constant alterations have been made as in the diagnosis and nomenclature of tumours—alterations which are very puzzling to the student, and the advantages of which have not as yet become at all evident to the practical surgeon. I will endeavour to treat the subject as practically and as shortly as possible, without ignoring the theoretical refinements which modern pathologists have introduced, yet only giving them such prominence as their bearings on practical surgery seem to demand.

A tumour is defined as 'a new formation —an addition to some part of the body of a substance organised or partly organised, and not the result of inflammation only' (Cæsar Hawkins), and this is probably the best definition which can be given, although we must allow that some genuine examples of tumour owe their origin to inflammatory processes—as, for example, the bursal tumours, of which an example is figured here.



FIG. 154. Two bursal tumours, i.e. enlarged bursæ patellæ, which had become converted into cystic tumours by the development of an imperfect fibrous material in their walls, leaving only a cavity in their centre, with smaller alveolar interspaces in the fibrous tissue composing their walls. Their cavities were filled with partially decolourised blood. The enlargement had existed for about two years. The tumours were removed at the same operation from a woman aged 34, successfully. (St. George's Hospital Museum, Ser. iv. No. 14b.)

Other tumours occur congenitally, either as the result of fœtal inclusion or from an abnormal and exclusive formation of epidermal tissues, or from unknown causes. And it may be stated generally that the cause of formation of any tumour is as a rule entirely obscure. Pathologists and statisticians have laboured in vain to discover any reason, either in the local or general condition of the body, why the individual should be affected with the growth of a tumour. Hereditary tendency is often traceable, especially in malignant tumour: but this affords no explanation, since we know no reason for the original occurrence of the tumour in the first member of the family; nor, beyond the vague fact that children usually resemble their parents in constitution and predisposition to disease, as they do in physical appearance and disposition, do we know any reason why the disease after it has once originated should be transmitted to succeeding generations. The fact, however, that cancer is often transmitted from parent to child is one of importance in diagnosis, though its importance is frequently overrated.

Innocent (homologous) and malignant

The most superficial acquaintance with tumours will show that there are two well-marked classes of them, separated by broad distinctions, both anatomically and clinically. There is one class in which the substance of the

tumour has an exact anatomical resemblance to some tissue of the body (*homologous* tumours), and in which the tumour gradually increases in size, displacing the structures in which it grows, but not invading them, and producing no other symptoms than those caused by its increasing bulk. Such tumours are clinically termed *innocent*, though, of course, the increase in their bulk may cause death, if they are situated in a vital part. There is another class of tumours which do not present any resemblance to the normal tissues, and which are therefore described as *heterologous*. Clinically these tumours show a strong local disposition to ulceration; they also invade all the textures of the part in which they grow, and they influence the general health, passing into the lymphatic system, appearing in remote parts of the body, reappearing after complete removal, and affecting the mass of the blood, so as to cause profound cachexia and ultimate death. Tumours of this kind are therefore called *malignant*. (heterologous) tumours.

But though there is no difficulty in placing the well-marked examples of either class under their proper category, either anatomically or clinically, it has long been seen that in both the anatomical and the clinical division a third class must be made, the classification of which is by no means so easy. There are some, such as the adenoid tumours of the mammary and prostate gland, which very nearly reproduce the structure of the part in which they grow; others, such as the 'fibro-plastic' tumours of Lebert, which are formed in a great measure of tissue resembling the embryonic state of some natural organ of the body; and others, such as the myxoma and glioma of Virchow, in which a similar though still more rudimentary resemblance to the normal tissue can be traced. Modern pathologists, especially the Germans, have revived for such tumours the old designation *Sarcoma*, which had originally no certain meaning, but is now defined as a tumour whose structure presents some resemblance to the rudimentary forms of some natural tissue of the body. The term Carcinoma is then defined anatomically as a tumour consisting of a congeries of cells resembling those of epithelium, and in some cases nearly identical with them, lying in the interstices of the connective tissue, in which again other cellular elements are to be found. But the cells of the carcinoma have no structural connection with this connective-tissue, nor do they appear to undergo any transformation into higher stages of development. Semi-malignant tumours. Sarcoma.

Looking, again, at these so-called 'sarcomatous' tumours clinically, we find that among them are well-marked examples of a third class, besides the innocent and the malignant, above spoken of. There are tumours which will recur after their complete removal; others which gradually spread to all the tissues in their neighbourhood, and others which ultimately destroy life by their ulceration, although they have not the other features of malignancy; that is, they do not affect the lymphatic system, nor make their appearance in remote parts of the body. To such tumours the term of *semi-malignant*, *locally malignant*, and *cancroid* have been applied. The class of sarcomata is largely formed of tumours of this kind; but what renders the subject so complicated and difficult, and prevents us from accepting the labours of modern pathologists in this direction as holding out any hope of finality, is that this same class contains some tumours which are perfectly innocent, and many others which are more truly malignant than some of those classed anatomically among the carcinomata.

Amidst all this confusion there is one important point to which Mr. Savory called attention in a very suggestive paper in the 'Brit. Med. Journ.,' Dec. 19, 1874, viz. that, speaking generally, 'the less the structures of which a tumour

is composed tend to change from their primary or embryonic form the more abundantly will they multiply; so that those tumours whose structures retain most nearly their primary form are the most malignant. And as the structures of the tumours are capable of transformation, so they lose their power of repetition; so that those tumours which consist most completely of fully-formed tissue are the most innocent.'

Thus the most lowly-organised tumours are the carcinomatous, the cells of which show no tendency to grow into any higher forms, and which consist in great measure of juice, which is partly, indeed, the product of the disintegration of the cells, but partly is a new morbid formation; and these tumours show all the characters of malignancy most plainly. Next in order are the sarcomatous, in which an attempt has been made at the formation of tissue, although imperfect and embryonic, and these tumours, though unstable in their composition, prone to ulceration, prone to recur after removal, and occasionally making their appearance in distant parts of the body, have all these characters in a far less degree than the carcinomatous tumours have; while the best examples of the purely innocent tumours are such as consist throughout of a highly developed tissue, such as bone. Many of the latter kind of tumours are as stable, and as little prejudicial to the health of the individual as if they had been original portions of his organism.

It remains to describe, as well as our present knowledge permits, the various kinds of the purely innocent, the sarcomatous, and the carcinomatous tumours.

Innocent tumours.

Innocent tumours are subdivided into cystic and solid. The cystic tumours are again subdivided into simple, or purely cystic tumours, and proliferous cysts, in which a growth springs from the cyst-wall and fills the cavity more or less completely.

The simple cysts, which consist merely of a fibrous envelope filled with fluid, are classified according to the nature of the fluid they contain. They are serous, synovial, mucous, sanguineous, and seminal. Milk-cysts, oily cysts, and colloid cysts, may be added, but the milk-cysts will come under notice with the diseases of the breast, and the others are merely pathological curiosities, for which the reader must consult some of the manuals of Pathology. Nor will anything further be said here about the synovial cysts or enlarged bursæ, nor the seminal cysts or encysted hydroceles of the epididymis. These will be found described in their proper places.

Serous cysts. Hydrocele of the neck.

Serous cysts occur very commonly in the neck, constituting what is called *hydrocele of the neck*, and this is the best example of their independent formation. The hydrocele of the neck forms a large encysted tumour (occupying sometimes the whole side of the neck, and falling like a dewlap over the chest), containing clear or slightly tinged serum, growing slowly, and producing no definite symptoms. I have seen such a cyst completely transparent, like a common hydrocele. These cysts are generally supposed to be formed by accumulation of fluid in the cellular spaces, which then produces by its pressure the stratification of the areolar membrane, and thus becomes encapsuled. Most of the other serous cysts, such as those which occur in the thyroid body, in the tunica vaginalis (common hydrocele), in the testicle (the non-malignant form of cystic disease of the testis), in the breast, or in the kidney, are formed by effusion of serum into spaces naturally existing in the organ, and their contents have some resemblance to that of the part in which they are formed. Thus, the serum filling these cysts is of the most various

colour and composition, in some cases almost watery, at others nearly the consistence of honey, and of every colour—sometimes black or nearly black,[1] at others perfectly colourless. More or less fat, cholesterine, or some of the elements of the blood, may frequently be found in it.

Mucous cysts are such as, being formed in or in the neighbourhood of a mucous surface, contain a fluid similar to that secretion, but usually more concentrated. Their cause appears to be the obstruction of a mucous follicle. They are found most commonly in the antrum, in the mouth (ranula), in the glands of Naboth and Cowper, and in the muciparous glands of the vulva and vagina.



Fig. 155. A blood-cyst situated on the leg. The patient was a healthy man, aged 30. The tumour had been noticed about two years, and had been the seat of repeated and severe hæmorrhage during the last three months. The drawing shows the deep fissures in the tumour from which the hæmorrhage proceeded. It shows also the shape of the tumour, springing from a broad base, pendulous, and overhanging the healthy skin for some distance. The tumour was removed, together with the skin around its base for some distance, in March 1873. The patient made a good recovery, the cicatrisation of the wound being assisted by skin-grafting. He was seen in good health five years afterwards. On examination of the tumour its walls were found to be composed of a thin layer of sarcomatous tissue, the cells from which are represented in Fig. 156.

Blood-cysts.

Sanguineous cysts occur either as a consequence of hæmorrhage into a serous cyst, which seems common in the neck (hæmatocele of the neck), or possibly in connection with a vein, the orifice of communication having afterwards become obliterated, or (possibly) from effusion of blood into the areolar tissue, which becomes condensed around the effused blood, or from effusion of blood into a tumour, the substance of which, expanded over the collection of blood, appears like a cyst. This was the case in the instance from which the annexed illustrations were taken. The patient, a man æt. 30, was under my care at St. George's Hospital, in consequence of repeated hæmorrhages from the large tumour which is shown growing from the outer side of the leg, and which is seen to be ulcerated in several places. The whole mass was excised, and was at first thought to be a simple cyst filled with blood; but minute examination by Mr. Beck and Mr. Arnott showed a thin layer of sarcomatous tissue in the wall, so that the case was really one of an enormous effusion of blood into the substance of a small tumour. The man did well and no recurrence took place. Again, blood-cysts are very frequently formed in malignant tumours, and they sometimes much exceed in size the solid growth in which they form, so that surgeons are always rather apprehensive of more serious mischief when dealing with these cysts.

Diagnosis and treatment of cystic tumours.

The diagnosis of simple cysts rests on several considerations. The synovial, seminal, and mucous cysts, forming as they do definite diseases of the parts in which they occur, are recognised mainly by their position. Cysts in general are distinguished from solid tumours (a distinction not easy to make when the

[1] As in some fluid from a mammary cyst preserved by Sir B. Brodie in the Museum of St. George's Hospital.

cyst is very tense and deeply seated) by their elasticity and perfectly rounded outline—from chronic abscess by the absence of all pain and inflammatory infiltration of the tissues around; and when any doubt is felt an exploratory puncture can never do any harm, gives hardly any pain, and will at once settle the question.

Serous cysts may often be treated successfully by iodine injection, exactly as in hydrocele, or they may be obliterated by a seton, though this sometimes sets up dangerous inflammation, especially in the neck. I once saw death occur in a week through the insertion of a seton into a cyst of the thyroid body. Any form of simple cyst may be obliterated by being freely incised and the incision kept open until the cavity has granulated up; but this treatment is hardly applicable to blood-cysts, on account of the danger of renewed hæmorrhage or of violent inflammation of their walls. They are better removed entire, whether by the knife or caustics, in which case, if truly simple, they will not recur; but if their wall is formed by sarcomatous tissue such recurrence is probable, and if by cancer-material is nearly certain.

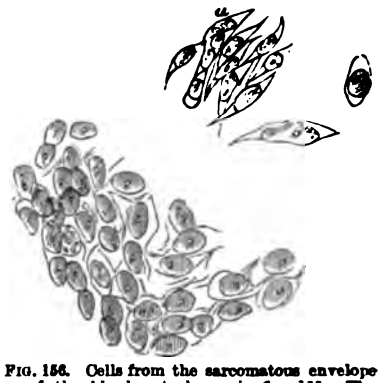


FIG. 156. Cells from the sarcomatous envelope of the blood-cyst shown in fig. 155. The large oval cells shown below formed the bulk of the tumour. Smaller spindle-shaped cells are shown at *a*. The sarcoma tissue formed a thin layer, not perceptible to the naked eye, in some parts arranged in slight bands shooting up into the papillæ of the skin or spreading beneath them; in others confusedly mixed up with the bloodclot which filled the cyst.—From 'Path. Soc. Trans.' vol. xxiv. pp. 208–214.

Compound cysts.

The compound cysts are (1) such as contain the elements of the skin—cutaneous cysts and dermal cysts; and (2) such as have growing from their lining membrane secondary cysts, or masses of solid substance, which ultimately either partly or entirely fills the original cavity—proliferous cysts.

Sebaceous tumours.

Of the former kind the commonest are the sebaceous, which are found mainly on the head and face, though most other parts of the surface may be affected, the axilla being remarkably exempt. Sir J. Paget describes them under two classes—one marked by a dark point on the summit, indicating the summit of a hair-follicle, and showing that the tumour was formed by the obstruction of such follicle; the other presenting no such opening, and probably formed in the same manner as any simple cyst. They contain usually inspissated sebaceous matter of a peculiarly offensive odour, more rarely fluid of various colours, mixed with epidermal scales and cholesterine. They grow often to a very large size, and appear in very large numbers in the scalp, and then the operation for their removal becomes a serious one, on account of the great liability to erysipelas in such cases; but there is some risk of this complication even after the removal of the smallest tumour, and pyæmia may also follow. I well remember the death of an apparently healthy young man from pyæmia very shortly after the removal of a little sebaceous tumour, the operation being a most trifling one—over in a minute—and of which neither the surgeon nor the patient thought much. Hence it is always desirable before performing any such operation to take all adequate precautions to see that the patient is in good health, and afterwards to take care that he does not expose himself injudiciously to any risk of cold or indulge in excess of any sort. The operation is usually a very simple one. The whole cyst being freely cut across and its contents allowed

to escape, it may be seized with a pair of forceps and dragged out, while the skin is held with the finger-nail or another pair of forceps; or, in the case of smaller tumours, the skin only may be divided, separated from the surface of the tumour with a few touches of the knife, and the bag turned out with the spoon-end of a director or the handle of the knife. When the skin is firmly united to the surface of the tumour, as happens in many regions from pressure, the surgeon will be unable to pull out the cyst, and more or less dissection is necessary.[1] Great care should always be taken to remove such a cyst entire. If a portion be left it may reproduce the secretion, prevent the healing of the wound, and set up a chronic form of ulceration with foul discharge much resembling that which accompanies epithelial cancer.

If there is any especial reason to dread erysipelas the caustic treatment is believed to be safer, i.e. to destroy the skin over the tumour to a sufficient extent with some caustic, so as to make a free opening into the cyst, and then either to leave it to discharge itself, draw it out, or procure its elimination by renewed applications of the caustic to its interior.

Congenital cutaneous cysts of the orbit.

Congenital cutaneous cysts are not of very rare occurrence. A very common situation for congenital cysts is at the outer upper angle of the orbit, forming a little round tumour, slowly increasing in that situation. Its early removal is necessary, or at least expedient, since the deformity it causes will ultimately render the operation inevitable, when it would require a larger wound and be more difficult; but the operation is never so easy as it would at first sight appear, since the cyst-wall is very thin, and it may extend very deeply into the orbit, lying constantly in close proximity to the periosteum, and even (as in a case which I once saw) perforating the bone and lying in contact with the dura mater. The dissection, therefore, should be conducted very carefully, all possible care being taken not to open the cyst—an accident which will much embarrass the dissection. If this has occurred it is perhaps best to lay the whole cyst freely open, and, after evacuating its contents, dissect it all carefully from the parts lying below it. Any little fragment of the cyst which has been left behind may prove a source of very serious trouble. These cysts usually contain thin fluid and hairs.

Of the scalp.

Cutaneous cysts in the scalp are often congenital, and they may then perforate one or both tables of the skull. But cysts have also been found in the interior of the skull, having been included within it in the process of its ossification. Such congenital sebaceous tumours are matters of singular interest, on account of the mistakes in diagnosis to which they may give rise. Many cases of meningocele or encephalocele have been mistaken for such sebaceous tumours and operated on, usually with a fatal result, though sometimes the patient has been lucky enough to escape with life. The greatest care, therefore, should be taken in examining a case of supposed sebaceous tumour lying in one of the usual situations of encephalocele to ascertain, in the first place, whether it is congenital, and secondly, whether pressure on it reduces it either wholly or partly, or causes any cerebral symptoms. If the tumour be reducible it can hardly be sebaceous, and there can be no doubt that it should be left alone. If pressure cause cerebral symptoms, it may doubtless nevertheless be a sebaceous tumour lying on the dura mater; yet even so the risks of its removal would be too great to render the operation, under ordinary circumstances, justifiable. If, however, an operation be undertaken, the tumour must on no

[1] It will often be found easier to dissect out one of these cysts after it has been laid open, if the dissection be begun from below, where the cyst lies loosely in the cellular tissue, rather than above, where the skin is firmly united to it.

account be opened. It must be exposed by very free incisions and careful dissection, and its base must then be separated with all imaginable care from the subjacent membrane.

Dermal cysts.

The other dermal cysts are most familiar to us in the ovary, and next to that in the scrotum. They contain masses of hair, portions of skin with cutis and cuticle, and frequently one or more teeth, mixed often with a large quantity of fat; and sometimes, besides these truly dermal structures, irregular pieces of well-formed bone are present in them. They seem to be often if not always congenital, though, like other congenital tumours, they may have remained for a very long time without growing. They used to be regarded as instances of fœtal inclusion, i.e. the elements of which they are composed were regarded as fragments of a blighted twin-fœtus which had been included in the body of the one which grew to maturity. But there is no reason whatever for such a supposition, in the case of the ordinary dermal cysts of the ovary or scrotum. They seem to be merely tumours growing in the fœtus, just as any other cutaneous tumour may in the adult. There are, of course, cases of well-marked fœtal inclusion, of which a portion of the body of one fœtus is buried in the other, while the lower limbs protrude, but these rare cases will form the subject of a further section. The dermoid cysts are now universally allowed to be, if not always, yet at least as a rule, quite independent of twin impregnation. Their diagnosis can only be conjectural before removal, resting on the long existence of the tumour, its irregularity and heterogeneous consistence. After removal no recurrence need be anticipated. In the scrotum they have been known to be spontaneously extruded by suppuration.

Proliferous cysts.

Proliferous cysts are those in which some solid substance springs from the interior of the cyst-wall, which may entirely fill it up. They occur frequently in the ovary, and still more often in the female breast. The proliferating solid portion of the tumour is a vascular tissue which springs from the wall of the cyst, generally at one definite part, but not uncommonly from a great part of the lining membrane, filling it up more or less completely, and ultimately making its way through the cyst and then through the skin out of which it fungates. Such are the serocystic, tuberocystic, or cystic-sarcomatous tumours. They are almost confined to the neighbourhood of glands, and are far more common in the female breast than in any other gland. I think, therefore, it will save space and time if I refer the reader to what is said in the chapter on DISEASES OF THE BREAST as to the diagnosis, pathology, and treatment of these tumours.

Cystigerous cysts.

Another kind of compound or proliferous cyst is the *cystigerous*, in which the lining membrane of the parent cyst becomes the seat of the formation of a number of secondary cysts. In the ovary such compound cystic tumours are very common; and in tumours which before removal appear to be simple cysts secondary cysts will sometimes be discovered. But I do not know that there is much importance in the diagnosis of this from the other form of compound cystic tumour or from the simple cysts.

Fatty tumours.

The *fatty* are amongst the most common examples of purely innocent tumours. They spring in almost all cases from the natural fat of the subcutaneous membrane, or in connection with deeper-seated fat. In some rare instances fatty tumours have been found in parts naturally destitute of any growth of fat, and fatty tumours have sometimes been found in patients who had died of exhausting diseases, and who had lost the natural fat from all parts of the body. They may grow to any size; and if developed in very early

life (which, however, is not common), they sometimes attain enormous proportions, as was the case in a child then aged seven years, from whom Mr. Pollock removed a fatty tumour which, being situated in the middle line of the lumbar region, had been mistaken for a spina bifida, and had therefore been allowed to grow. When removed it weighed 12 lbs.[1] I saw her many years after, in perfect health. Fatty tumour does not often appear at so early an age as in this instance. In other respects the case illustrates the common history of fatty tumours: their gradual growth to a large size, without any tendency to suppuration or to degeneration of any kind, or to ulceration of the skin, their size being the only inconvenience, and the complete restoration of the health on their removal. A fatty tumour is often deeply lobulated (as in Fig. 157), but sometimes smooth and globular; in either case it is generally enclosed in a capsule formed by the condensed areolar tissue, and therefore easily separated from the parts around. The skin is generally attached to the surface of a fatty tumour by numerous strings of areolar tissue; and when the skin is moved on the tumour, dimples are produced in it by the tension of these attachments, a point somewhat characteristic of fatty tumour. The lobulated surface, soft, solid feeling, and slow growth are the other characters of this form of tumour, and are usually sufficient for its diagnosis. Occasionally this, like other forms of tumour, is the seat of neuralgic pain, and this is especially the case in young women, who often have fatty tumours in the shoulder or in the neighbourhood of the breast. In rare cases cysts are found in fatty tumours, and in still rarer instances abscesses may form in them.



Fig. 157. A large mass of fat under the skin of the scrotum, collected into lobules, and continuous with the fat of the abdomen. The patient died of phthisis, and the rest of his body was much emaciated. The case is described at length by Mr. Gray, in the 'Path. Trans.' vol. vi. p. 230.—(St. George's Hospital Museum, Ser. xiii. No. 14.)

Fatty tumours generally form after the period of maturity, but in some rare cases they occur congenitally, as was probably the case in a remarkable instance of fatty tumour, growing in the interior of the spinal canal, which I assisted Mr. Athol Johnstone to remove, and the history of which will be found in the 'Path. Soc. Trans.' vol. viii. pp. 16-28.

Besides the definite and encapsulated collections of fat which deserve the name of tumours there are often met with, especially in very fat, elderly people, enormous ill-defined outgrowths of fat and cellular tissue—such as used to be called 'lipoma.' These have no capsule, but gradually pass into the fat of the part. It may become necessary to remove them on account of the inconvenience they cause; but the operation should not be lightly undertaken. In order to be efficient for its purpose it must involve a very large incision, and the patient is generally not a very good subject for operation.

Fatty tumours are not uncommonly multiple.

[1] 'Path. Soc. Trans.' vol. viii. p. 360.

The removal of a fatty or any other perfectly innocent tumour is merely a question of convenience. The tumour must be expected to increase slowly; but if the patient is out of health or there is any other special reason for dreading an operation, it may be better to advise him to bear what is after all only a deformity and an inconvenience, rather than incur any real danger. But in most cases the operation involves such trifling risk that it should be at once performed. If the tumour has not been irritated, its attachments will be so loose that if it is lifted in one hand from the subjacent fascia, while with the other hand the surgeon makes a free incision across the whole of the mass, he can turn it out of its capsule with his fingers in a moment, without any dissection. If, on the other hand, the tumour has been irritated or compressed —as, for instance, is often the case in the tumour on the shoulder by the pressure of braces or shoulder straps—the skin will adhere to it, and it will require formal dissection.

Fibrous tumour.

The purely *fibrous* tumours are also typical examples of the innocent class. Their external characters are not always easy to distinguish from those of fatty tumours, when they grow in the subcutaneous tissue; and, indeed, in this situation the two textures are frequently intermingled, so as to form a *fibrofatty* tumour; but the true fibrous tumours are harder, rounder, and less adherent to the skin than the fatty. Fibrous tumours occur in connection with the uterus, with the nerves, the bones (especially the lower jaw and the base of the skull, where they form the 'nasopharyngeal polypus'), the testicle, the lobe of the ear, and in many other parts. The fibrous is often mixed with other texture, as in the uterus, where an admixture of the unstriped muscular tissue is constant (fibro-muscular). In the nerves the disease forms a special affection, and will be described in a future chapter under the name of 'Neuroma.' The progress of a true fibrous tumour is usually slow; those of the uterus are prone to a retrogressive change, in which they calcify more or less completely;[1] the others usually advance slowly till they protrude through the skin or mucous membrane and ulcerate. Sometimes cysts form in their substance—'fibro-cystic tumours'—as is not uncommon in the bones (see DISEASES OF BONES). The true fibrous tumours are usually enclosed in a capsule, rendering their removal both easy and safe; and after removal, if the tumour be found to be composed of perfect and well-formed fibrous tissue, no recurrence need be apprehended. There have, it is true, been a few instances in which tumours supposed to be purely fibrous (and that by competent observers) have afterwards run the course of cancer; but these exceptional instances of what perhaps was after all only an accidental error of observation need not interfere with the general statement that a slowly-growing tumour, definitely separated from the surrounding parts, and composed of well-formed fibrous tissue only, will not recur after complete removal. The more rapid the growth is, the more embryonic or ill-formed the fibres, and the more they are mixed with cells, and especially cells of variable shape and size, the more is recurrence to be dreaded. And this leads us to speak of the *fibrocellular* tumours.

Fibro-cellular tumours.

These contain, along with the fibrous element, a more or less large proportion of cells. They grow more rapidly than the purely fibrous tumour, they occupy more variable positions, and are often more deeply situated, and they are less definitely marked off from neighbouring parts and less frequently encapsuled; they often contain glandular elements, when they grow in or in the neighbourhood of glands. Each of these circumstances has its value in the

[1] See the chapter on Diseases of the Female Generative Organs.

prognosis of the disease; but in the present state of our knowledge it is very difficult to estimate that value, or to give a consistent and intelligible account of the tumours grouped under the term 'fibrocellular.' Some of them are, as far as can be judged, as purely innocent as the typical examples of fibrous tumour,[1] others are of a very malignant nature. The latter are such as will be found described below under the names of round-celled and spindle-celled sarcoma, myxoma and glioma. The innocent fibrocellular growths are those in which the fibres are well-formed, having attained their perfect development, and the cells are homogeneous, generally round or oval, and display little tendency either to growth into fibres, to proliferation, or to decay. Such are the cells frequently found in the fibrous epulis on the jaw, and in the firm fibrocellular growths of the skin. The cells usually bear only a small proportion to the bulk of the fibrous tissue.



Fig. 158. A mass of fibrocellular tumours, removed from the labium pudendi, weighing 7½ lbs. avoirdupois. They were removed by operation, and only one vessel required the ligature. They had given the patient (a widow, aged 40) very little inconvenience during the three years they had been growing, until one burst and discharged a thin sanious fluid. *a* refers to the skin and fat of the labium; *b* to the pendulous fibrocellular outgrowths. (Museum of St. George's Hospital, Ser. xvii. No. 47.)

The diagnosis between the firmer fibrocellular and the true fibrous tumours is only possible after removal, and the looser kinds are again very difficult to distinguish in many situations from cancerous tumours. Their removal is urgently indicated, and in the less well-defined specimens the surgeon will do well to cut as wide of the disease as prudence permits.

Enchondroma.

Cartilaginous tumours (enchondromata) are far more common as outgrowths from bone than in any other part, and they will accordingly be described further among the DISEASES OF BONES, where also will be found some illustrations of their most characteristic forms. But they do occur also in the soft parts, frequently in the parotid gland, occasionally in the testicle, and very rarely in the subcutaneous tissue, in the thyroid body, and in other parts. They are distinguished from the harder fibrous tumours, which they much resemble, mainly by their firmer consistence and deeper lobulation. They are as a general rule purely innocent, and if once removed entire will never recur. Sir J. Paget has, however, recorded[2] a single instance in which a cartilaginous growth originating in the testicle, and presenting every character of an ordinary enchondroma, passed up the lymphatic vessels, pressed

[1] Paget, in speaking of fibrocellular tumour, says: 'What has been said of the excision of fatty tumours might be repeated here, and so might the statements as to the very favourable prognosis after removal; but with this reserve, that if a fibrocellular tumour be incompletely developed, soft, looking like little more than size or other soft gelatine, or presenting a great preponderance of its elemental structures in an embryonic state, it is likely to prove recurrent.' ('Syst. of Surg.' 2nd ed. vol. i. p. 525.)

[2] 'Med.-Chir. Trans.' vol. xxxviii. p. 247.

upon and perforated the vena cava inferior, and was thus conveyed into the lungs, where it attained so large a size as to prove fatal. This case is a very striking and instructive one; it does not, however, show—nor does Sir J. Paget record it as showing—that enchondroma is ever, when occurring unmixed, a malignant disease, but as proving that the elements of any growing tissue if they pass into the blood may become multiplied there to an indefinite extent.

Besides the purely cartilaginous tumours—i.e. those which consist of cartilage and nothing else—there are a great number of tumours, some innocent and others malignant, which consist partly of cartilage; but as the cartilage in these tumours forms only a part, and that a subordinate part, of the growth, and does not give its character to the disease, it seems to me erroneous to classify such tumours as enchondromata. Thus cartilage is often found in osteoid cancer, and the recurrent growths in the lung often consist in great measure of cartilage. This illustrates the presence of cartilage in cancer, while the common fibrous tumour of the parotid or the ordinary fibrous epulis will often be found to contain more or less cartilage; and these may be used to illustrate its formation in innocent tumours. But such tumours should be classified under the name of their principal constituent, and the name enchondroma should be reserved for those growths which consist entirely or almost entirely of cartilage.

Cartilaginous tumours degenerate in various ways. Some break down in the centre, so as to form large cysts (cystic enchondroma), others soften throughout, others become converted into a calcareous mass, in which it is difficult to discover any definite organisation. Many ossify, but this is far more common in those which are attached to bone than in those formed in the soft parts, and it will be spoken of along with DISEASES OF THE BONES, in connection with the subject of exostosis.

The free removal of an enchondroma is all that is necessary for the patient's future safety. Amputation may be indicated if the size and connections of the tumour demand it, and in cases of multiple enchondromata on the fingers or toes it may be the only resource available; but such cases will be discussed hereafter.

Exostosis.

Bony tumours are not absolutely unknown in the soft parts. There are some rare cases in which the muscles ossify, as in a skeleton preserved in the Museum of the Royal College of Surgeons, in which many of the bones are connected immovably by masses of bone which have replaced some of the largest muscles in the body; and other singular cases occur like that recorded by Mr. Cæsar Hawkins,[1] in which masses of bone were formed loose in the cellular tissue of the muscles. But such cases are so very uncommon and have so little bearing on practice that exostosis may be regarded as a disease of the bones, and will accordingly be treated of in that chapter.

Vascular tumours. Aneurism by anastomosis.

The only other form of innocent tumour is the vascular, in which the bulk of the disease is composed of enlarged vessels, these vessels being either arterial, capillary, or venous. The tumours which are formed chiefly of enlarged

[1] 'Contributions to Pathology and Surgery,' vol. ii. p. 193. Mr. Hawkins describes the formations of bone in the case which he relates as the result of ossification of the muscular fibres in consequence of inflammation, and refers to some similar instances; though, as he observes, 'we cannot say why the muscles inflame, nor why the common results of inflammation are modified so that bone is formed in the cellular tissue of the muscles.'

arteries are called aneurisms by anastomosis. They are large, irregular lobulated pulsating masses, in which a considerable bruit can often be heard, and numerous large vessels can be traced into them on all sides. The capillaries share in the enlargement, and the veins thus receive the pulsation. As the arteries enlarge their coats become thinned, so that the distinction between the arteries and veins around the tumour becomes impossible. The growth of the tumour sometimes causes ulceration of the skin, and severe or even fatal hæmorrhage; but apart from this there is not much danger, and I have seen cases which have gone on for an unlimited time without material change. Sometimes, however, when the disease occurs, as it usually does, on the head, the constant noise is so distressing, and the increase of the tumour so threatening, that the surgeon is compelled to interfere.

The diagnosis is usually obvious. At the same time I have seen a pulsating cancer of the skull mistaken for aneurism by anastomosis and operated on, the patient being with difficulty saved from death on the table. A more accurate examination would have shown in this case that the skull was perforated, for pressure on the tumour produced vertigo, loss of consciousness, and partial hemiplegia.



Fig. 159. Aneurism by anastomosis of the upper lip. From a drawing presented by Sir B. Brodie to the Museum of St. George's Hospital.

The favourite seats of this disease are the scalp and the lip. In the scalp they are commonly close to the ear, and the disease often extends into and implicates the vessels of the ear.

They have been treated by all kinds of operations. When small they might possibly be cured by setons or by ligature applied as to an ordinary nævus. The large tumours are best treated by the galvanic cautery. The wire being passed through the mass at its base is then attached to the battery, so as to bring it to a white heat, and is drawn slowly out to the surface, cutting the tumour into two parts and searing the divided surface as it cuts, so that no hæmorrhage occurs. This may be repeated in several places, and so the tumour will be divided by several cicatrices, by which the vascular tissue will be obliterated. As fresh parts threaten to grow they must be treated in the same way. Bleeding may occur during the separation of the sloughs, and must be combated either by the ligature or actual cautery.

The total removal of the tumour is a still more certain method of treatment, but the operation is highly dangerous when the growth is large. An incision is made around a part of the base of the tumour, cutting across several large vessels, which are then tied. If the patient has not lost too much blood the cut is then extended around another part or the whole of the circumference, and again the divided vessels are tied. When the whole circumference has

thus been dealt with, the mass is rapidly removed and all vessels at its base secured. In large tumours it is often necessary to divide this operation into several, allowing an interval between each for the recovery of the patient from the results of hæmorrhage. The ligature of the main trunk artery (the common or external carotid) has often been practised in aneurism by anastomosis; even the common carotids on both sides have been tied, with a due interval. But I cannot discover that the practice has been so successful as to justify the operation. Mr. Southam has published a successful case,[1] but here the seton was also employed. On the other hand, I remember a remarkable case in which the patient had been in great danger from repeated hæmorrhage. This had been suppressed and the patient restored to health and comfort by the persevering use of the galvanic cautery. Three years afterwards the bleeding recurred, and a surgeon was sent for, who, unluckily for the patient, tied the common carotid. The man bled to death fifteen days afterwards, while the ligature was still firm on the vessel.[2] At the same time cures are claimed after this operation, the reality of which I am not concerned to dispute. All that I would say is that I believe local cautery to be safer and more efficient.

Nævus. Capillary and venous tumours are called nævi,[3] and nævi are also divided into cutaneous and subcutaneous, the purely venous nævi being usually subcutaneous, those entirely confined to the skin being always capillary only; while those in which the skin and cellular tissue are affected simultaneously are usually of the mixed kind; and in all such cases large veins will be seen running away from the tumour.

The obvious difference in surgical anatomy between nævus and other congenital tumours consists in the large size and great number of the vessels in nævus. But there are many intermediate stages between the simple congenital fibrous or fibrocellular tumour, such as we sometimes see on the skin or mucous surface of the mouth, the fibrocystic tumour sometimes containing a large quantity of blood in its cystic spaces (a tumour which often occurs congenitally in the neck), and the true nævus, in which the blood is contained in enlarged vessels, rather than vascular spaces, the number and size of which masks the fibrous framework which supports them. Such congenital tumours are undoubtedly of the same nature as nævus, and nævi often degenerate into masses almost exactly similar to some of these forms. Hence some pathologists regard nævi as congenital fibrous tumours, in which the different arrangement of the fibrous stroma has necessitated a corresponding enlargement of the vascular channels.

The nature of the common nævus, or mother-mark, is obvious at first sight, and in some more serious cases the whole or great part of the side of the face is implicated in a similar dilatation of the capillaries, called 'port wine stain,' or along with the enlarged vessels there is a pigmentary formation, and often an overgrowth of hair. Mr. Morrant Baker has published an instance of the successful extirpation of one of these hairy moles ('Med-Chir. Trans.' vol. lxi.). The ordinary capillary nævus is very common indeed; and as a great many (I think the majority) of such nævi remain without any growth indefinitely, they should be left alone, unless from their situation they occasion any unpleasant deformity, or from their growth it becomes necessary to treat them, in which case, if they are in a position where a scar is of no consequence, they should be removed either by ligature or with the knife.

[1] 'Med.-Chir. Trans.' vol. xlviii. p. 65.

[2] 'Lancet,' 1858, vol. ii. pp. 75, 339.

[3] Some authors also speak of aneurism by anastomosis under the name of 'arterial nævus.'

latter is safe enough if the tumour be avoided, but as the former is quite free from all risk of hæmorrhage it is more commonly used, especially in private practice. Two stout harelip needles being passed beneath the nævus at right angles a strong ligature is tied beneath them as tightly as possible. If the mass is large it is well to cut a groove in the skin from each needle to the one next it for the ligature to lie in. The great point is to tie the ligature tight enough, in which case there is no pain afterwards. The surgeon may be certain that the tumour is completely strangulated if he pricks it with a needle here and there while the ligature is drawn tight, and sees that at last only a little serous fluid oozes from the punctures. The points of the needles should be cut off with pliers made for the purpose, and a strip of lint wound under them and round their ends. When the mass has turned black the needles may be removed and a poultice applied till the slough drops off. The subcutaneous nævi may be removed like any other subcutaneous tumour, by dissecting the skin from above them and removing them without opening the capsule in which they are contained ; [1] or if at any stage of the operation the surgeon should meet with alarming hæmorrhage the ligature may be substituted. And in nævi which are only partly subcutaneous a similar operation may be performed, i.e. the skin may be dissected from the mass below, generally without much hæmorrhage, and the latter be thus removed. But I cannot say that, in the few trials I have made of this method, I have seen much use in the skin so preserved. It is, in fact, so thin and ill-nourished that it generally sloughs or withers away.

Ligature of nævus.

Enucleation.

The caustic treatment of small nævi is very satisfactory. The caustic generally used is nitric acid, or the acid nitrate of mercury, which will remove a small mother-mark in two or three applications, leaving, however, a small depressed cicatrix very like that of vaccination. The actual cautery by means of a whitehot needle, or a point of whitehot metal with a bulb above, by which the heat is prevented from too suddenly being quenched, is also often used, and successfully. But many of these small nævi may be removed with less deformity by the application of the electrolytic current : i.e. a current of electricity of very low power continued for some time, so as to disintegrate the tissues without cauterising them.

Caustics.

Electrolysis.

The electricity in these cases is best supplied from a Stohrer's battery in which one needle is plunged into the nævus while the other may either be applied to the skin, or be also driven through the tumour, but so as not to be in contact with the former. As the disintegration progresses, the position of these needles is to be frequently changed and reversed. No sloughs should be produced.

Another plan which should be mentioned is vaccination. If the child has not been previously vaccinated he may be vaccinated on the nævus, the vaccine being introduced in a great many places very close together. The object is to obliterate the vascular tissue by the inflammation produced around the vaccine pustules. But the plan is not one which deserves recommendation. It is very uncertain, since the vaccine may be washed away by the blood, and it has usually, if not always, failed in the cases which I have seen ; and when vaccine pustules are produced it by no means follows that the nævus is cured, or that the child has obtained the proper immunity from small-pox.

Vaccination.

Again, subcutaneous nævus, especially those large nævi which sometimes

[1] See Teale, in 'Med.-Chir. Trans.' vol. l. p. 57. The existence of a complete capsule subdividing the growth into lobules is very distinctly described in the account which Mr. Birkett has given of the structure of a nævus in the 'Med.-Chir. Trans.' vol. xxx. p. 193.

Coagulating injection.

occur in the parotid region, may be treated by the injection of perchloride of iron. The method, however, is a dangerous one, one case, at least, being on record in which instant death was caused, probably by coagula carried into the heart.[1] If it is employed the solution should be used in small quantity, three or four drops being injected through the hypodermic syringe first in one place and then in another, and the situation of the tumour should be surrounded if possible by an elastic ring or temporary ligature. Some surgeons first break down the tissue of the nævus with a broad cutting needle, and then introduce the coagulating injection into the cavity so produced.

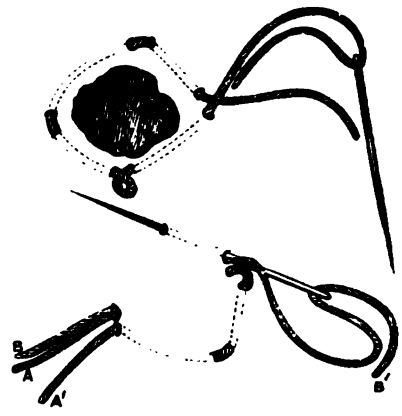
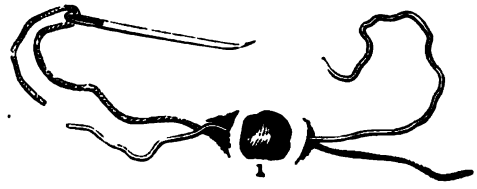


Fig. 160. Subcutaneous ligature of nævus. The upper figure shows a single ligature carried round the tumour. The lower (in which no tumour is depicted) shows a double string carried below the centre of the base, then divided into two, A A' and B B', and each of the two carried subcutaneously round half of the nævus, and then tied.

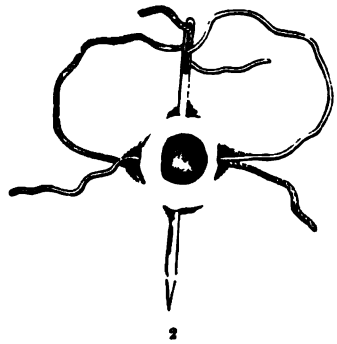
Subcutaneous ligature.

The larger nævi require complicated forms of ligature for their strangulation. Those that are entirely subcutaneous are generally treated by the subcutaneous ligature. The needle (which should be a large

1. The threaded needle passed under the centre of the base of the tumour; one thread divided near the needle.



2. The other end of the divided thread passed into the needle's eye. Both threads carried round a quarter of the circumference and passed under the base at right angles to their former direction



3. The needle withdrawn and the nævus strangulated in quarters.

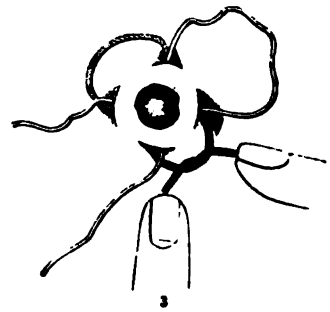


Fig. 161. 'Fergusson's knot,' for the strangulation of large nævi, or other tumours. In order to keep the diagrams of a convenient size the tumour has been represented relatively much smaller than it is in practice; and in Fig. 3 the incisions, which are usually made through the skin from each puncture to the next, have been omitted, to avoid complication. They are not absolutely necessary, if the mass is not very large, but they reduce the quantity of tissue which is to be cut through by the ligature, and promote the success of the operation, besides very probably saving the patient some pain while the ligature is separating.

curved one) is armed with a strong piece of whipcord. This is entered at one point of the circumference, and carried round the base as far as possible, when

[1] Teale, 'Med.-Chir. Trans.' vol. l. p. 62.

it emerges through the skin. The ligature having been drawn through as far as necessary is re-entered at the same puncture and carried round another portion of the circle, and so on, till at length it reaches the original point of entry, through which its two ends now protrude and must be tied as tightly as possible. Or if the mass is too large to be dealt with in this way the ligature may first be carried under the middle of the tumour, and may then be divided into two, each of which is applied as before subcutaneously to each half (Fig. 160). Another excellent knot for a large nævus is that which goes by Sir W. Fergusson's name, and which is represented in Fig. 161.

In other cases, where the tumour is of an elongated form, the form of ligature represented in Fig. 162 is more appropriate. The tumour is strangulated in pieces by passing a double ligature under its base from side to side, as there shown. The ends of the ligature are coloured differently—say one white and the other black. Each loop is left long, so that the whole ligature must be of great length. Then the white loops are divided on one side and the black on the other, and the pairs of white and black strings are tied tightly. The whole tumour will thus be found to be strangulated.

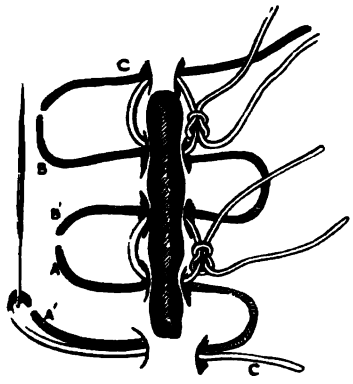


Fig. 162. Ligature for strangulating a large nævus. The white loops are divided on one side, and the black on the other, and the corresponding ends (as A A', B B') tied together. The terminal strings C C may be either tied or withdrawn, as the surgeon thinks best.

The two latter methods necessarily involve the death of the skin, and even although the purely subcutaneous ligature does not, perhaps, involve the death of the skin, by absolute necessity, since enough nutrition may be provided by the vessels which pass into the skin between the punctures to avert gangrene, yet such a fortunate result is not often obtained. More commonly the subcutaneous ligature sets up extensive inflammation, in which the whole tissue perishes, including the skin.

Mr. Barwell has described a process for the 'scarless eradication' of nævus[1] by means of an instrument whereby a wire conveyed subcutaneously around the base of the tumour is gradually tightened by means of an appropriate mechanism until it comes away, and so divides all the vessels which nourish the subcutaneous part of the nævus. After this the cutaneous nævus can be treated with nitric acid if necessary, but often withers away and disappears spontaneously.

Another plan which will often check the growth of large nævi, and which is eminently useful in situations where their complete removal is impossible or very dangerous, is to cut them into pieces by ligatures conveyed under their base and tied tightly round the entire tissue. If the growth be so large that the first ligature will not ulcerate through it, a second can be introduced into the groove which the ulceration of the first has caused, and thus when the ligatures have come away the tumour will be divided into portions by wounds, in which bands of cicatrix will form, and so its growth will be arrested. A case of venous nævus in the scrotum treated successfully in this way will be found described and figured in the 'Path. Soc. Trans.' vol. xv. p. 95.

[1] 'Lancet,' May 8, 1875.

There are other methods of treating nævi too numerous to mention. I need only add that very large nævi are often cured by the introduction of setons. Some surgeons steep the seton-threads in perchloride of iron.

Degeneration of nævi.

Nævi which do not grow may remain stationary, or may disappear, or may degenerate. In some cases, usually after an attack of some grave illness, such as scarlet fever or whooping-cough, even large nævi have been known to disappear altogether. Thus in the discussion on Mr. Teale's proposal for enucleating the large nævi which sometimes form in the parotid region, Mr. Prescott Hewett related an instance in his own family where a nævus of this kind had entirely disappeared soon after one of the common affections of childhood. In other cases the tumour after ceasing to grow degenerates into a cystic mass, and this is a well-known cause of congenital cystic tumour. The contents of the tumour may vary very much from the composition of the blood, though they generally show some trace of their origin.

Sarcoma.

Sarcomatous tumours are defined to be such as in their formation and growth present some resemblance, though an imperfect one, to the formation and growth of the normal tissues. The class of semi-malignant or locally malignant tumours belongs to the sarcomata, but many sarcomata are innocent, and others, on the contrary, are extremely malignant. The classification, therefore, does not seem to me, I own, a good one, or likely to be permanent; but as it has lately come much into vogue it seems better for the present to adhere to it. The general characters of sarcomata are, that they consist of fibrous tissue more or less perfectly formed, and of cells which display some resemblance to the normal cells of either embryonic or adult fibres, membrane, muscle, bone, cartilage or nerve, the cells and fibrous tissue having an organic connection, and the former showing a tendency to higher development.



Fig. 163. Round or oval-celled sarcoma. From a tumour of the female breast, described in 'Path. Trans.' vol. xix. pp. 394–397, and figured in the same volume as pl. xii. fig. 6.

The class of sarcomata, therefore, embraces a considerable number of those tumours which have been described above as 'fibrocellular,' and it very nearly coincides with the tumours described formerly as 'fibroplastic,' the only difference being that under the term sarcoma many tumours have been included by the German pathologists which are of a truly malignant clinical nature, and which used to be described as cancer. Taking this definition, the following are the tumours which are arranged by Billroth under the head of sarcoma:—

a. Round-celled, or granulation sarcoma (Fig. 163), in which the chief constituents are small round cells like lymph-cells, such as are found in granulations, the intercellular substance being either distinctly fibrous or fibrillated, or perfectly homogeneous, as in the neuroglia or transparent sheaths of the nerve-tubes (glioma).

b. Spindle-celled sarcoma (Fig. 164), which is composed of small elongated cells (oat- or awn-shaped), sometimes without any intercellular substance, at

other times united by a homogeneous, fibrillar, or fibrous tissue. The cells are variously regarded as embryonic connective tissue (Lebert), or embryonic nervous or muscular tissue (Billroth).

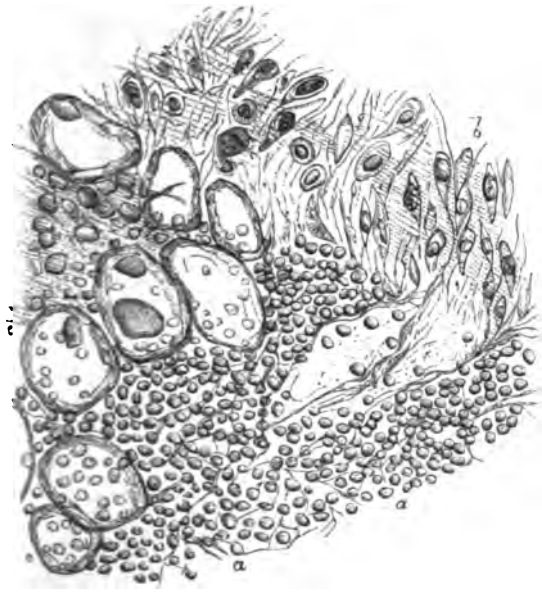


Fig. 164. Section from a spindle-celled sarcoma of the femur, taken from the exterior of the tumour. *a* shows the 'indifferent granulation material' or 'adenoid tissue' stretching out from the tumour structure (*b*) into the adipose tissue (*c*) separating its cells. The tumour was of a malignant character, and contained in other parts of its substance cartilaginous and osteoid material. ('Path. Soc. Trans.' vol. xi p. 341, and pl. viii. fig. 1.)

c. Giant-celled sarcoma or myeloid tumour (Fig. 165), in which the cells distinctive of the form of tumour are very large, contain numerous nuclei (sometimes as many as twenty or thirty), and are often provided with numerous offshoots. These cells are likened to those which occur in the marrow of fœtal bones. Such cells are found mixed up with the tissue of any of the other forms of sarcoma, but they are most common in tumours which spring from bone. These tumours will be further spoken of in the chapter on DISEASES OF BONE.

d. ***Mucous*** or ***net-celled*** sarcoma[1] (*myxoma*, Virchow) (Fig. 166), characterised by the development of caudate branching cells communicating with each



Fig. 165. 'Giant-celled Sarcoma,' or myeloid tumour.—After Billroth. *a* points to a part where cysts were being formed by the softening of the tissue of the tumour; *b*, to a focus of ossification.

[1] Myxoma is included by Mr. Butlin ('Syst. of Surg.' 3rd ed. vol. i. p. 267) among the innocent or homologous tumours. He says, however, 'It is not improbable, if all the tumours included in this class could be traced back to their natural condition, the class might cease to exist; for most, if not all, of the mucous tumours are imperfectly developed or degenerated examples of cartilaginous, sarcomatous, or other growths.'

other, and bearing a resemblance to the structure of the gelatinous tissue of the umbilical cord or that of the vitreous body. Mixed with this is commonly a variable quantity of soft mucous substance (colloid) or soft tissue, more or less resembling cartilage; and bone may also be found in these mucous sarcomata.

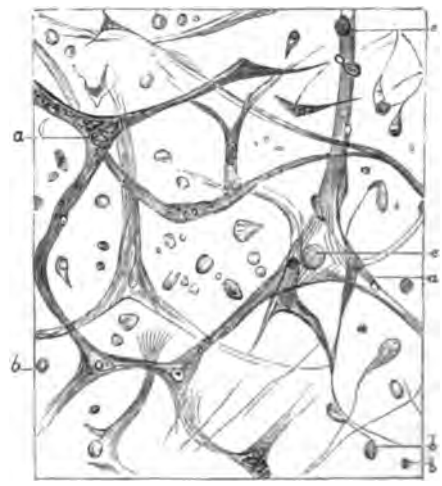


FIG. 166. Section of Myxoma. *a*. Angular or stellate bodies, the prolongations of which anastomose so as to form a network traversing the whole section. *b*. Small round cells, having no apparent connection with the angular corpuscles. *c*. Corpuscles having much resemblance to mucous corpuscles, but smaller, contained in the prolongations of the branching or angular bodies. These prolongations had double outlines, and appeared to form canals, in which the mucous corpuscles were contained. Some fatty tissue was mingled with the structure of this tumour. (From 'Path. Trans.' vol. xx. p. 344.)

e. Billroth's next class of sarcomata is the *alveolar* (Fig. 167). He allows, however, the great difficulty of distinguishing the structure from carcinoma, and his description hardly shows any difference between this form of tumour and epithelioma. The cells are round, larger than lymph-cells, with one or more large nuclei, containing glistening nucleoli, and about the size of cartilage-cells, or moderately large flat epithelium. They lie in the interstices of a beautifully alveolar cellular tissue.

f. Finally, we have the *pigmentary* or *melanotic* sarcoma, in which one or other of the above forms of sarcoma is coloured black or dark brown by the deposit of granular pigment, which almost always occurs in the cells, and more rarely in the intercellular substance also (Fig. 173, p. 358).

Cylindroma.

I may refer here to a peculiar class of tumours called Cylindroma by Billroth, and to which other names have been applied by other pathologists.[1] The characteristic anatomical feature in these tumours is that they contain long cylinders, sometimes perfectly structureless, in other cases filled with roundish or radiate or spindle-shaped cells (Fig. 168). These cylinders have been believed to be modifications of the rudimental connective or mucous tissue, or of the rootlets of the lymphatic vessels. According to Paget such structures may occur in tumours in different regions of the



FIG. 167. 'Alveolar Sarcoma.'—After Billroth.

[1] Cylindrical cartilaginous tumour; mucous cancroid; cylindrical sarcoma; siphonoma. See Paget, 'Lectures on Surgical Pathology,' 3rd ed. p. 472. Mr. Butlin remarks that the name 'Cylindroma' has led to a confusion between this form of tumour and the cylindrical form of epithelioma, with which it has nothing in common.

body, and the growth may be entirely innocent, or recur in the scar after operation. In the only case which I have myself treated, the tumour was of a most obstinate nature, but was I believe ultimately and finally eradicated by a combination of the knife and cautery. It formed in the scalp after a wound received in the trenches before Sebastopol, and was not finally cured till the year 1876. The cylindrical elements were not recognised till the final operation; but the man was under my treatment for many years.

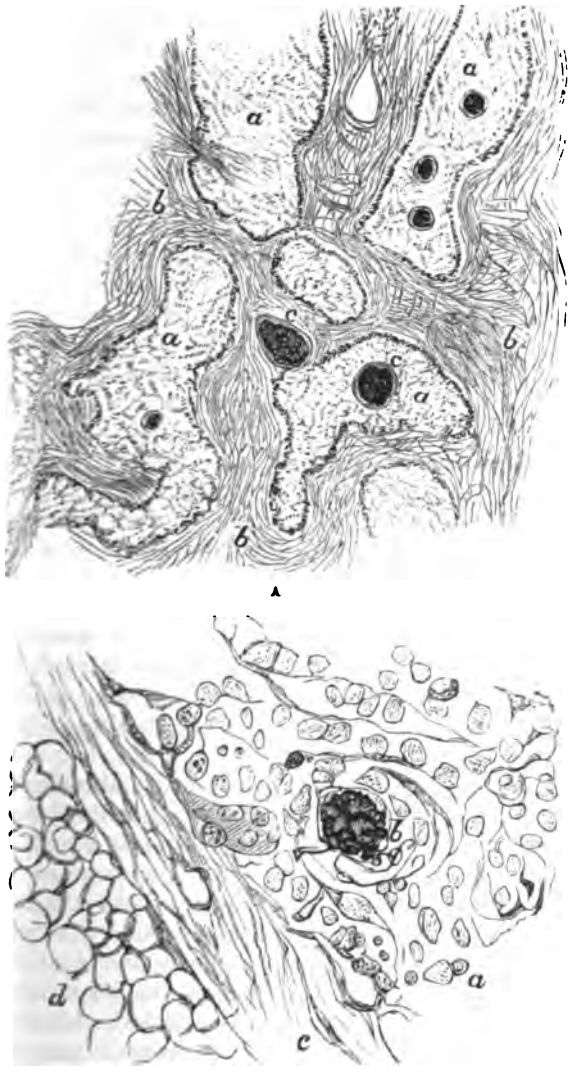


Fig. 168. Cylindroma. A. A sketch to show the general arrangement of the elements of the tumour; *a* the cylinders, filled with epithelial cells; *b* the fibrous tissue separating them; *c* masses of cells arranged in a bird's-nest form. B. A more highly-magnified preparation of the cells contained in the cylinders; *a* indifferent cells, of the 'granulation' type; *b* one of the bird's-nest masses; *c* fibrous tissue; *d* fat. From a preparation by Dr. Watney, taken from the case referred to in the text.

I have thus given the anatomical division of this class of tumours from one of the most recent and most authentic of the German pathologists, in order to place before the reader, as intelligibly as I can, the views which have recently prevailed. Not that surgeons or pathologists are by any means agreed upon those views. For instance, Billroth's alveolar sarcoma is not recognised by other authors,[1] and seems to me, according to his own description, to belong rather to carcinoma; and melanotic tumours are certainly in the human subject often regarded as carcinomatous; but the other members of Billroth's series are usually admitted as distinct anatomical forms of tumour, and classified as sarcoma.

Their clinical characters are unfortunately very variable. We only know of glioma as occurring in the interior of the eye and in the brain. In the latter

[1] See the very useful and practical account of the anatomy of tumours by Dr. Moxon in Bryant's 'Practice of Surgery,' chap iii.

position its separate clinical history cannot be traced, since it causes death by its situation. For its description as it occurs in the eye I must refer to the chapter on DISEASES OF THE EYE.[1]

Some of the other sarcomatous tumours are among the 'recurrent' or locally malignant' type, and many others are decidedly cancerous in their clinical history. The spindle-celled sarcoma is in some of its forms identical with the recurrent fibroid of Paget, or the fibroplastic tumour of Lebert. Such tumours will when removed, however completely, occasionally but not always recur in the cicatrix of the operation, and their repeated recurrence will cause death. Thus, the Museum of St. George's Hospital contains specimens from a case of this kind, in which a fibroplastic tumour, or spindle-celled sarcoma, originally developed in the female breast, was removed ten times, until at length the extent of tissue implicated by it became too great for adequate removal, and the patient died exhausted by its ulceration, eighteen years after its first appearance.[2] Further, there are cases, though not so numerous, in which tumours of this sort recur, not in the cicatrix, or not there only, but in the internal viscera, usually the lungs or the liver, very much after the manner of cancer. For example, Mr. Mitchell Henry[3] many years ago related a case in which a myeloid tumour amputated at the shoulder-joint recurred both in the stump and in the lungs; and I have myself recorded a case in which a fibroplastic tumour of the thigh, recurring after imperfect removal, was amputated at the hip-joint, and the patient died some months afterwards, with a similar growth in the pelvis, in the lungs, the brain, and in other still more remote parts of the body—viz. the spine and the thorax—the stump of the amputation being all the time quite sound and healthy. The structure of the tumour in this case was minutely examined both before and after recurrence by several experienced microscopists, so that its nature cannot be doubted.[4] In another case, where the breast had been removed for a large fibroplastic tumour, the growth recurred in the cicatrix, and afterwards in the opposite breast, which I also removed; but the recurrence was not checked, and it ultimately proved fatal.

There is no question that when these sarcomatous (myeloid and fibroplastic) tumours are thus diffused into remote parts of the body the elements of their diffusion are sometimes carried by the veins; and Billroth claims to have been one of the first to show that sarcoma (contrary to what is very common in carcinoma) never attacks lymphatic glands, and he therefore believes that it is through the venous system that such infection proceeds in sarcoma. It is now, however, admitted that sarcomatous tumours do sometimes affect the glandular system. What is more important to the surgeon is to know whether sarcoma can be diagnosed from other less dangerous forms of tumour, and whether after removal any prognosis can be arrived at—i.e. whether the surgeon can say, with any approach to accuracy, whether the tumour will recur or no.

With regard to the diagnosis between sarcoma and carcinoma at an early stage—i.e. before any glandular affection has been developed and before the skin has given way—it can hardly, I think, be established definitely. The diagnostic signs which Billroth points out are as follows: 'Sarcomata develop

[1] Since glioma is only connected with the neuroglia, it is often described as a different form of tumour from the ordinary sarcoma, which springs from connective tissue, and this is the view taken in the chapter on DISEASES OF THE EYE.

[2] St. George's Hospital Museum, Ser. xvii. Nos. 58 to 60.

[3] 'Path. Soc. Trans.' vol. ix. p. 367.

[4] 'Path. Soc. Trans.' vol. xvii. pp. 217, 290. See also the woodcuts and report on p. 292.

with peculiar frequency after previous local irritations, especially after injuries; cicatrices also are not unfrequently the seat of these tumours; black sarcomata (melanosis) may come from irritated moles. Skin, muscles, nerves, bone, periosteum, and, more rarely, glands (among these the mamma most frequently) are the seats of these tumours. Sarcomata are rarest in children, rare between ten and twenty years, most frequent in middle life, and rarer again in old age. . . . The growth is sometimes rapid, sometimes slow; the consistence varies, so that it can rarely be used as a point in diagnosis' (lib. cit. p. 618). To these diagnostic signs Billroth adds that sarcomata are usually encapsuled, and carcinomata are not; but as it is certain that the more rapidly growing sarcomata are not encapsuled, this can hardly be regarded as diagnostic. I need scarcely say that the above diagnostic signs are far indeed from establishing any reliable distinction by which sarcoma and carcinoma can in all cases be distinguished; in fact, this is often hardly possible, even after removal and careful examination. And I may also remark that subsequent experience has considerably modified the views of surgeons as to several of the statements here quoted from Billroth. Thus Mr. Butlin says that sarcoma in some parts (such as the testicle and tonsil) always affects the lymphatic glands, and that sarcoma is the usual, perhaps the only, form of malignant disease in childhood.

The rapidity of their growth is that which more than anything else distinguishes the sarcomatous from the purely innocent tumours; and the only indication, as far as we know as yet, of the probability of recurrence is drawn from this rapidity and from the succulence of the growth. Rapidly-growing soft tumours are regarded with much more apprehension than those of firmer consistence and slower increase. In any case the prognosis is better if the tumours have been very early and very freely removed. Even after one or more recurrences the case is not absolutely hopeless. Cases are on record where, after the second or third removal, no further development of the disease has taken place, and such cases render it the plain duty of the surgeon to interfere, and at the earliest possible moment, when recurrence is ascertained; though, as a rule, a tumour which has once recurred will go on doing so; and the more rapidly it recurs the more rapidly it will in all probability ulcerate; and, as a general rule, the oftener it has been removed the shorter will be the patient's next respite. Sarcomatous or fibroplastic tumours when ulcerated much resemble cancer; but as there is certainly more hope of successful removal in the former than the latter, it is important to draw the distinction; and this is made chiefly by the amount of infiltration of the surrounding skin. A tumour which fungates out of a cleanly-cut hole in the skin is probably sarcomatous; one in which the tissue of the skin around the hole is œdematous, hardened, and studded with nodular masses is in all likelihood cancerous; and the diagnosis of cancer becomes established if the glands are implicated.

Carcinoma.

The words 'cancer' and 'carcinoma' are sometimes used as synonymous and equivalent to the term 'malignant tumour;' by other authors this use is made of the word 'cancer' only, by which is then meant a tumour presenting the clinical characters of malignancy, while the term 'carcinoma' is made to be strictly anatomical. In the latter terminology, which is perhaps now the more common, all carcinomatous tumours are also cancerous or malignant; but the term cancer applies also to many of the sarcomatous tumours, as will have been seen from the above description of the latter. Carcinoma is defined anatomically as a tumour which is composed of an areolar framework of fibrous

tissue, within which areolæ are contained collections of cells bearing a considerable resemblance to those of the epithelium, and believed by most modern pathologists to be developed from that structure, so that they deny the possibility of *carcinoma* taking its origin anywhere except on the surface of the body, whether external or internal, including, of course, in the surface the deeper layers of the epithelium and all the involutions formed by ducts, follicles, &c.; though no one denies that *cancer* or malignant disease originates in situations such as the interior of bones, in the substance of the brain, and innumerable other localities far away from any pre-existing epithelium.

Taking this definition of carcinoma, it would be defined as consisting of a network of fibres in which may be found the nuclei peculiar to connective tissue, and contained in these areolæ a mass of cells varying in shape, size, and special characters in different examples, and even sometimes in the same example of the disease, but all of them bearing some resemblance, more or less distinct, to the normal epithelium. The cells show no tendency to pass into a higher stage of development, as those of sarcoma do, nor have they any organic connection with the fibrous stroma. On the contrary, they are marked by a tendency to fatty degeneration and often contain oil-globules, and the whole tumour tends more or less rapidly to degeneration and ulceration.

Carcinoma is prone to affect the lymphatics leading from the part in which it was originally developed; so that the glands next in order are very commonly found to be the seat of a similar tumour, and this glandular formation, when confined to the glands immediately connected with the primary tumour, is by many surgeons considered rather in the light of a portion of that tumour than as an extension of the disease. And certainly the disease often stops for a time at these first glands. But from this first range of glands it will pass either to more remote glands or will infect the mass of the blood and reappear in the remotest parts of the body. Meanwhile the primary tumour has been locally infecting the tissues in its neighbourhood, and thus making its way to the surface either of the skin or of a neighbouring serous or mucous cavity. In its course it breaks down, as above stated, so that its structure presents traces of fatty degeneration in the form of small dots of a yellow cheesy consistence, visible to the naked eye, and in the presence of a creamy juice (so-called 'cancer-juice') which can be scraped or squeezed from its section. The cancer-juice, however, is not entirely formed by the breaking down of the tumour. In some cases it certainly may be so, in great part—as shown by the quantity of oil and débris which it contains—but in other cases it shows only well-formed and perfect cancer-cells, and is regarded with great probability by many pathologists as the medium in which the cells grow, and by which they are propagated to the parts around.[1] When the disease has made its way to the surface an indolent ulcer is formed, with hard, elevated edges, the cancerous material being infiltrated into the integument for a variable distance, the surface of the ulcer varying in character according to the form of the disease. These cancerous ulcers are very prone to hæmorrhage, and the patient's life, if not cut short otherwise, is gradually worn out by the bleeding and the exhaustion of the discharge. Carcinoma kills, however, in many other ways. The growth of the primary tumour interferes with the functions of vital organs; or the disease is propagated into one of the great viscera; or it infects the mass of the blood, causing a peculiar cachexia, which sometimes proves fatal without any obvious mechanical cause.

The forms into which carcinoma is divided are as follows:—

[1] See Savory, 'Brit. Med. Journ.' Dec. 19, 1874.

1. Hard cancer or scirrhus—carcinoma fibrosum—hard spheroidal-celled carcinoma (Butlin)—very common in the female breast. This is distinguished by its stony hardness (hence popularly called stone-cancer); it feels like a lump of some hard foreign substance let into the part; in its growth its structure often shrivels, so as to draw the neighbouring tissues to it, producing an apparent loss of size, glueing the integument to the surface, and causing the dimple of the skin so often seen in this form of cancer, and the retraction of the nipple which so commonly occurs when it is situated in the breast. Stretching out from the main tumour may often be found indurated strings, being the cellular tissues infiltrated and drawn in towards the tumour. It was these projections which, being fancifully likened to a crab's claws, gave the disease its name. Scirrhus.

When cut into, scirrhus presents a characteristic hardness, feeling like a raw potato does when cut; its section is whitish or greyish, dotted with minute yellow points, and its surface often presents a concavity caused by the shrinking



FIG. 169. Microscopical appearance of scirrhus of the breast (after H. Arnott). 'The typical form of hard cancer. To one side of the section are drawn a few detached and larger cells from another specimen of undoubted scirrhus of the breast, showing more clearly the varying size and shape of these cells and their occasional multiple nuclei.' ('Syst. of Surg.' vol. i. fig. 13, opposite p. 614, 2nd ed.)



FIG. 170. Cancer stroma (after H. Arnott). 'A very thin section was made, through a tolerably firm pink-white cancerous nodule, in the liver of a patient dying with hard cancer of the breast, and the cells brushed away with a camel's-hair pencil under water. There is thus left the typical stroma dimly fibrillated and granular, enclosing meshes which have been closely filled with cells.' ('Syst. of Surg.' *ibid.* fig. 18.)

of the tumour. The tissue of its exterior passes into that of the healthy structures by no exact or defined margin.

Examined microscopically it shows a stroma which is often extremely definite—the cells are 'of an epithelial type, of varying size and shape, but with tolerably uniform (and usually single) large nuclei, closely packed in the meshes of a stout fibrillated stroma, without any visible intercellular elements.'[1] The stroma, which many pathologists regard as merely the compressed connective tissue of the part, is believed by Mr. Arnott to be, often, at any rate, a new formation.

This form of scirrhus, collected into a separate nodule, is called the *tuberous* form; the other is the *infiltrating*, in which the cancer appears more as a general induration of all the tissues in the neighbourhood, the skin being thickened, tense, and livid, and adhering closely to the parts below ('hide-bound cancer'); the disease spreads slowly and superficially, ulcerating in one part, and possibly afterwards healing there while spreading in other parts.

The ulceration of a scirrhous tumour leaves a sluggish sore, with sharp edges, bounded to a variable distance by cancer-tissue, sometimes with a

[1] H. Arnott, in 'Syst. of Surg.' 2nd ed. vol. i. p. 614.

nearly flat surface, at others with prominent granulations, and with a peculiar fœtid discharge, the smell of which much distresses the patient, and which is mixed with more or less blood from time to time. Such ulcers may heal for a time, leaving a thin livid scar, very prone to break down again.

Scirrhous cancer may be operated upon, whenever the skin is unaffected and the glands are not implicated, with a tolerably certain prospect of benefit, from the cessation or prevention of the stabbing pain which often accompanies the growth of the tumour, and from the removal of what is a source of constant annoyance and apprehension to the patient. Cases are also unquestionably on record in which the tumour has never recurred, but these are so rare, especially if we insist on anatomical evidence of the correctness of the diagnosis, that they need hardly be taken into account, and as a general rule the return of the disease must be anticipated. Nor is there, as far as I know, any conclusive evidence that the operation prolongs life, for it must be remembered that the course of scirrhus is sometimes very slow, and against the few cases in which no return has taken place for many years after the operation may be set, perhaps, as many in which the tumour, having never been interfered with, has remained indolent and innocuous for a very long time, until, perhaps, the patient has died of old age, or of some other affection, or after this long interval, cancer has shown itself in other parts of the body.[1] But there is certainly no reason to say that operations shorten life; and as they give a period of immunity, and usually with very little danger, they should be performed in all appropriate cases.

Even when ulceration has occurred to a considerable extent I have known the operation successful in procuring a considerable period of health and avoiding impending death from hæmorrhage.

The question of operating when the glands are affected is a doubtful one. If all the affected glands can be removed, there seems no reason why the operation should not be as successful as in any other case, since the glands, as has been said above, are rather a part of the primary disease than a propagation of it; but it must be allowed that in the axilla especially it is extremely difficult to remove them all, without a most formidable and frequently fatal operation, those that are obvious being only a superficial part of a chain of glands which often stretch deep into the axilla; and where a second chain (as, for example, the cervical glands, in cancer of the breast) has become involved, it is unjustifiable to operate.

When there is a second tumour perceptible in a remote part of the body, or any symptoms of the formation of such a tumour, the operation is inadmissible, as also when the presence of general cachexia testifies to the infection of the mass of the blood.

Medullary cancer.

2. The next variety of carcinoma is the encephaloid, medullary, or soft cancer—soft spheroidal-celled carcinoma (Butlin)—in which the cells are more plump, rounded, and usually more uniform in size and shape, and the alveolar stroma less distinct. This form of cancer is often secondary to scirrhus, so that a primary scirrhous tumour in the breast will be accompanied by the growth of medullary carcinoma in the glands or viscera. It grows much more rapidly than scirrhus, is often exceedingly vascular, so that large blood-cysts are formed in the interior of the tumour, and its surface is very commonly permeated by large veins. To the most vascular examples of this form of cancer Mr. Hey's

[1] In the 'Path. Trans.' vol. xi. p. 220, is the account of a case in which the scirrhous tumour had existed for more than thirty years, and then deposits of cancer took place in various parts of the skeleton.

name, 'Fungus hæmatodes,' is still occasionally applied. This form of cancer differs from scirrhus in the greater softness of the whole mass (whence the name), in the relatively smaller proportion of the intercellular substance, in the greater juiciness of the tumour, and the more rounded shape, larger size, and more varying form of the cells.

The favourite seats of encephaloid cancer are the bones, the female breast, the eye, the testicle, and less frequently the uterus, bladder, and other viscera; but any tissue of the body may be affected by it. It occurs very commonly in young people in blooming health, and its nature is often overlooked at first, it being mistaken for innocent tumour, or for abscess, from its extreme softness when not covered by any hard tissue, or for chronic inflammation in the testicle when bound down by the firm tunica albuginea. It rapidly affects the glands, and when removed it generally rapidly recurs, so that the prognosis is even more unfavourable than in scirrhus. Nevertheless operations are eminently justifiable in this form of cancer. They certainly tend to prolong life,



FIG. 171. Medullary cancer. 'From a lymphatic gland—secondary to hard cancer of the breast. This form of cancer differs from scirrhus only in the proportion of the cell element to the fibrous stroma—the cells being here seen to be still of the epithelial type, and lying close together, without any visible intercellular substance.'—From Arnott, *ibid.* fig. 18.



FIG. 172. Melanosis, springing from the mucous lining of the urethra. *a*. The urethra laid open. *b*. The prepuce. *c*. The section of the corpora cavernosa. The disease was removed by amputation. The man lived for some years and died of another affection.—St. George's Hospital Museum, Ser. viii. No. 10a.

and usually they restore the patient for a time to complete health. When left to itself the tumour speedily makes its way through the skin, ulcerates, and bleeds copiously. If death is not caused in this way it is occasioned by the rapid growth of the tumour.

Some peculiarities in encephaloid cancer as it exists in bone deserve especial notice, viz., its tendency to ossify and its occasional pulsation. The reader is referred to the section on cancer in bones later on.

As subvarieties of encephaloid I would name melanosis and osteoid cancer. Melanosis. Melanosis, or black cancer, is usually developed from parts, such as the eye or the skin, where pigment is always or commonly found in the natural state. When occurring in the skin it seems often to originate in a mole. The liver, again, is a tolerably common seat of melanosis, and it is found comparatively often as a secondary formation in many other parts of the body, such as the brain or the bones. It also originates in parts where no pigment naturally

exists (Fig. 172). The pigment is deposited chiefly in the cells and also to a certain extent in the intercellular substance.

That melanosis is clinically a malignant disease in man is a fact to which I have not as yet met with any well-marked exception.[1] But that the disease is always or even usually of the character which would be technically called carcinoma by all pathologists is a very different matter. The anatomical characters of the tumour may either be those of soft cancer, as shown in fig. 17 of Mr. Arnott's plates,[2] or of spindle-celled sarcoma, as in a remarkable instance, under my own care, of melanosis of the urethra, here figured.



FIG. 173. The cells which were found in the microscopic examination of the tumour shown in the previous figure. *a*. Section from the peripheral part of the growth showing 'indifferent' or 'granulation tissue,' with isolated pigment-cells among it. At one point a bloodvessel is seen. *b*. A portion of the growth more highly magnified, showing large spindle-shaped branching cells, many of them quite filled with pigment.—From a drawing by Dr. T. H. Green in the 'Path. Soc. Trans.' vol. xxiii. p. 176.

Osteoid cancer.

Osteoid cancer is a very rare form of the disease. Its primary seat is almost always in the bones; but it presents the remarkable peculiarity of forming secondary deposits of bony cancer in the glands and in the viscera, and of recurring as a bony mass in remote parts of the body. In all cases that I have seen the lungs have been the seat of the secondary growth. The primary tumour is usually, as Mr. Moore describes it, 'a mass of the hardest enamel or ivory-like bone,' mixed with which are the materials of ordinary encephaloid cancer, and often a considerable proportion of cartilage. And sometimes the primary tumour has been judged to be of the common encephaloid nature, while the recurrent growth in the lungs has been osteoid.[3]

The diagnosis of osteoid cancer is sometimes rendered self-evident by the presence of bony masses in the glands, otherwise it can only be formed by anatomical examination or by the nature of the recurring tumour. I would refer the reader to the chapter on DISEASES OF THE BONES for further particulars with regard to this form of cancer.

Epithelioma.

The other indubitable form of cancer is the epithelial, or epithelioma. This form of cancer takes its origin from the epithelium of the part in which it grows, and is therefore always developed from the surface, or from the parts in contact with the surface of the skin, or mucous membrane. A favourite seat of epithelioma is the orifice of some cavity (mouth, anus, vagina, urethra), where the skin and mucous membrane become continuous. It usually appears as a hard flattened lump, the surface of which easily breaks down and ulcerates, and which readily affects the nearest glands. Its connection with simple inflammation is very close; the continuous irritation of some foreign substance is an undoubted cause of the disease, as, for example, that of a clay pipe in causing epithelioma of the lip or tongue,[4] of soot in the rugæ

[1] In exceptional cases, however, recurrence after operation may be long delayed. Mr. Pollock removed a melanotic tumour from the thigh, and afterwards one which showed itself in an inguinal gland. No recurrence had taken place fifteen years afterwards.

[2] Even in this plate it is doubtful, as Mr. Arnott says, whether the anatomical characters are not rather those of round-celled sarcoma.

[3] 'Syst. of Surg.' 2nd ed. vol. i. p. 574. Osteoid cancer is now usually regarded as a form of sarcoma in which the sarcomatous element goes on to chondrification, calcification, or ossification. However this may be, it is a most malignant form of tumour.

[4] Cancer of the tongue is rarely seen in the female sex, and cancer of the lip hardly ever; but a distinguished surgeon at Edinburgh told me that he had seen numerous examples of cancer of the lip among the Irish women of that town, who are constantly smoking short clay pipes.

of the scrotum in causing chimneysweep's cancer, of retained secretion under a phimosed prepuce in causing epithelioma of the penis. And the enlargement of the glands is often due merely to ordinary inflammation, and will subside completely after the removal of the tumour. On microscopic examination the epithelial elements are very distinct, in the form of large nucleated cells, often bearing a very close resemblance to those of the epidermis, frequently arranged in concentric laminæ like the layers of a bird's nest (squamous epithelioma); in other cases, and especially where the disease affects a mucous surface with cylindrical epithelium, as the intestine, the epithelial cells also are of the cylindrical type (cylindrical epithelioma). This is most perfectly seen in the rectum, and is classed by Mr. Butlin as a separate form of cancer from the ordinary epithelioma, since in it the cell-nests which he regards as characteristic of that form of carcinoma are not met with. It should be remarked that the word 'cylindrical' is applied to the form of cells found in this species of carcinoma. In the ordinary epithelioma the epithelial cells are often found arranged in cylinders, as they are in the cylindrical sarcoma above described (page 350). And it should also be noticed that the bird's-nest arrangement of the epithelial cells, though very characteristic of epithelioma, is not peculiar to it. 'Similar cell-nests are formed in other morbid structures, in papilloma for example, and they exist even in normal epidermis. In the epidermis of the tongue exquisite specimens of cell-nests may often be discovered' (Butlin). Epithelioma is epecially prone to break down and ulcerate, and is the form of cancer which usually gives rise to the cancerous ulcer described in a subsequent chapter.



Fig. 174. Epithelioma. 'A section through a chimneysweep's cancer of the scrotum, representing two nests ("laminated capsules," "globes epidermiques"), the larger one displaying the structure of these bodies—plump epithelial cells in the midst, surrounded by drier and flattened scales; whilst the smaller shows a more common appearance, the cells being so flattened and altered as to resemble a ball of hair; both nests were embedded with numerous others in the subcutaneous tissue.'—From Arnott, *ibid.* fig. 21.

Epithelioma, although it appears to me to realise more exactly than any of the other forms of cancer the anatomical descriptions of carcinoma which are accepted at the present day, in the distinct derivation of its cell-forms from the epidermal tissues, and the completeness of its fibrous stroma, yet is commonly much less 'malignant' than the other forms of cancer, i.e. it destroys life less quickly, and after removal it returns much less speedily, and often as it seems does not return at all. Its removal, therefore, is a matter of urgent necessity, and a more encouraging prognosis may be given than we can honestly give in scirrhus or soft cancer.

Colloid.

There are two other forms of tumours which are by some classified as cancers, while others deny their cancerous nature, viz. colloid and villous. It appears probable that colloid at any rate is very frequently cancerous, or at least malignant. Its synonym is Alveolar cancer, derived from the arrangement of

the fibres of its stroma in large open meshes of transparent fibres, in which are seen rounded or oval nuclei. Lying in the interstices of these fibres is a transparent jelly-like substance, in which will be seen under the microscope cells of various sizes and shapes, the most characteristic being large, round, and flat, formed of a nucleus, around which are numerous concentric laminæ, very much like an oyster-shell, besides which there are others which approach more or less closely to the forms usually seen in epithelioma. The favourite seat of colloid is the peritoneum, especially its omenta, though it is found also in the female breast, in the limbs, the rectum, and the face. Many of the cases which are now described as myxoma would formerly have been classed as colloid. The title of colloid to the designation of cancer has been much questioned, and more particularly of late years by Mr. Sibley ('Med.-Chir. Trans.' vol. xxxix.), who speaks of it as never infecting the glands, as not prone to affect the liver

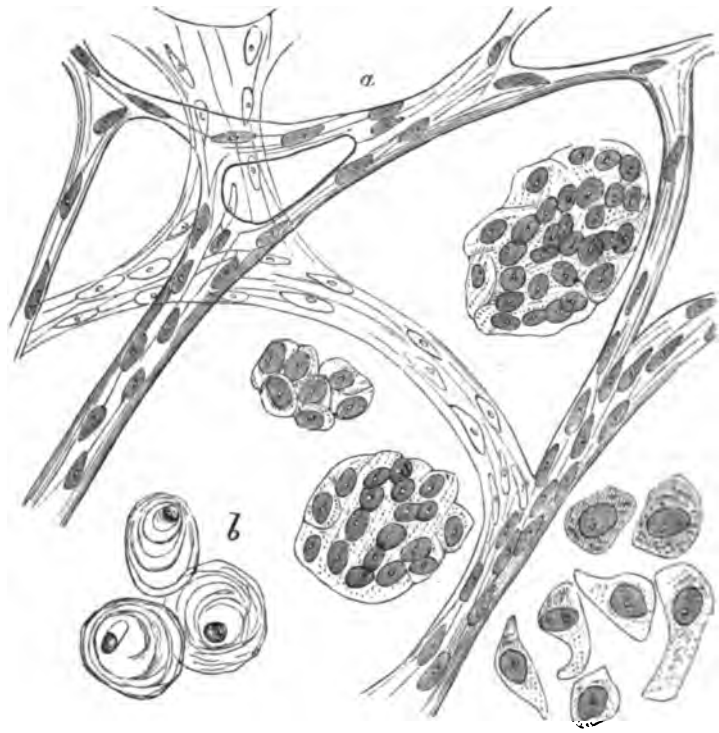


FIG. 175. Colloid cancer. *a*. From a drawing by Mr. Arnott, in 'Path. Soc. Trans.' vol. xxiii. pl. 10. It shows clusters of cells of the epithelioid type (those at the right hand of the drawing very large and irregular in shape), floating in spaces bounded by a delicate fibrous network, which forms large oval and spherical meshes. This stromal tissue is closely beset with elongated oval nuclei. *b*. Also from Arnott, in 'Syst. of Surg.' 2nd ed. Fig. 23, shows some cells which are very characteristic of colloid cancer—'round or oval, mononucleated, and having within the outer cell-wall several very delicate concentric lines, giving to the cell somewhat of an oyster-shell appearance.'

or lungs, as true cancer peculiarly is, and as not prone to recur after complete removal. The anatomical characters of colloid, however, certainly seem to agree in essentials with those of carcinoma, and, as far as can be judged by the rather rare cases which become the subjects of surgical operation, it is quite as prone to recur as epithelioma is, and cases in which the glands have been affected are not wanting. It appears probable, as Mr. Croft has said,[1] that 'some tumours are colloid in character from the outset, others appear to under-

[1] In the account of the case from which Fig. 175 is taken, 'Path. Soc. Trans.' vol. xxiii. p. 268. See also Butlin, op. cit. p. 288.

go a colloid change,' and it may be possible that the nature of the developed tumour may depend on that of the one which it has replaced.

Villous tumours, or papillomata, are now almost universally allowed to be in general not cancerous. They spring from mucous surfaces, and the situations in which they are most commonly found are in the bladder and rectum. Very striking instances have been put on record of the difference which generally marks their course from that of cancer.[1] Nor is the anatomy of the disease that of cancer. The tumour consists usually of a loose floating mass of processes with a dendritic arrangement, springing from a base, in which no cancerous elements can be detected. The villous processes are composed 'of a fine membranous envelope like the finger of a glove, enclosing a quantity of granular matter in which numerous cells are embedded, which are chiefly spheroidal in form and cannot be distinguished from those of the membrane adjacent to the villous growth.' These villi bear the most exact resemblance to the villi of the chorion.[2] It appears, however, undeniable that cancers may be covered by a similar villous growth. The anatomical difference, therefore, between a simple and cancerous villous growth would rest on the presence or absence of cancer underlying the villous surface. Clinically the rapidity of growth and acuteness of symptoms would enable the surgeon to form a diagnosis, which, however, in many cases would be only conjectural. Villous.

These are all the new growths which appear to me to require separate description as coming within our definition of tumours. For the other forms of growth which are described in some systematic treatises under the head of tumours, I would refer to other parts of this work. Thus the reader will find Lymphoma or Lymphadenoma spoken of under the Diseases of the Absorbent System; Neuroma under those of Nerves; Adenoma under those of the breast, prostate and other organs where polypi of that kind are met with.

[1] See below, in the chapter on diseases of the bladder, an illustration taken from a typical case of villous tumour in that organ; and see 'Path. Trans.' vol. xii. p. 120 for a striking example of villous tumour of the rectum. In both these cases the tumour was clearly of an innocent nature.

[2] See a paper by Mr. Sibley in 'Path. Trans.' vol. vii. p. 212, where the villi from tumours of the intestine and bladder are figured side by side with those of the chorion.

CHAPTER XVIII.

SCROFULA.

Scrofula.

THE terms 'struma' and 'scrofula' are usually regarded and employed as synonymous; but some writers make a difference, and a very important one, between the two. In the most intelligible sense of the words, and in the class of cases which are most easy to diagnose, scrofula or struma is the constitutional diathesis which leads to (or which tends to lead to) the deposit of a sub-

Tubercle.

stance called 'tubercle' in various organs of the body. Tubercle is described as being of two kinds, the grey or miliary, and the yellow or crude. The latter is now regarded by most authors—following the authority of Virchow—as a secondary stage of the former. Grey or miliary tubercle is 'a greyish-white, translucent non-vascular body of firm consistence and well-defined spherical outline, usually about the size of a millet-seed. Although in its earlier stage it is uniformly translucent, its central portions quickly become opaque and yellowish, owing to the retrograde metamorphosis of its component

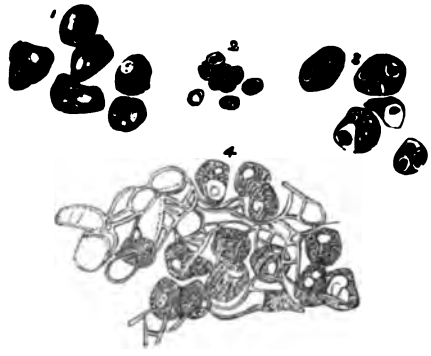


FIG. 176. Elements shown by teazing out a miliary tubercle, after Rindfleisch. 1. The large tubercle cells. 2. The small tubercle cells. 3. Endogenous cell-development. 4. Delicate reticulum from the interior of a miliary tubercle, the cells partly removed by pencilling.



FIG. 177. Section of a vessel contained in a tubercle of the brain. A. Tubercular tissue. B. White blood-globules. C. The lumen of the vessel filled with granular fibrine. Magnified 400 diameters. From Cornil and Ranvier.

elements. In structure tubercle, like the other "lymphomata," consists of lymphatic cells contained in the meshes of a very delicate reticulum. The cells are mostly round, or roundly oval, colourless, transparent, and slightly granular bodies, much resembling lymph-corpuscles; and, like these, vary considerably in size; many of them contain a small distinct nucleus. In addition to these there are a few larger cells containing two or even three nuclei.'[1] The grey miliary tubercles themselves are described by Mr. Treves as an aggregation of smaller bodies, which are designated 'lymphoid,' or 'reticular,' or 'primitive' tubercles, and the microscopic structure of which he thus describes:—

'Speaking generally, the structure of this elementary tubercle is as follows: It forms a roundish microscopic mass of cells that may be divided into three zones. The central zone is represented by one or more giant cells,

[1] Green's 'Pathology,' pp. 146–7.

the next zone is composed of a number of large cell-elements with clear and pellucid contents and that have been somewhat erroneously termed "epithelioid," and the most external zone consists of a mass of leucocytes. The cells forming the little district are supported by a more or less distinct reticulum, and with this reticulum the branched processes of the giant cells (when such processes exist) are said to be continuous. The altered tissue fuses gradually into the surrounding structures, and the whole of the affected area is conspicuous by its deficient vascularity.'[1]

These minute grey granulations are often aggregated together into larger masses, and then, though the granulations themselves are essentially non-vascular, vessels may be found in the interstices of the aggregate mass which belong to tissues interposed between the component parts of the mass. The deposit of miliary tubercle is peculiarly apt to follow the course of the small arteries and capillaries, and seems first to occur in the 'adventitia,' or fibrous envelope of the vessels.[2] Such vessels are, however, according to Cornil and Ranvier, always impermeable, their cavity being filled with granular fibrine mixed with white blood-globules. The presence of the white corpuscles, according to these observers, testifies to the gradual progress of the obliteration. This aggregate of tubercle softens into a yellow caseous substance, and in that condition forms the *yellow* or *crude* tubercle.[3] Besides the cells figured above as typical of tubercle, all sorts of débris are met with in microscopical examination—'ill-formed epithelial cells, masses of pigment, crystals and plates of cholesterine, remnants of enclosed and disintegrating tissue' (Savory). Latterly the existence of a special and characteristic bacillus in tubercle, which had been previously asserted by other microscopists, has been reaffirmed by Koch, and supported by a demonstration through a new staining process. This demonstration has been accepted as conclusive by many competent observers, and Mr. Treves speaks of it as 'apparently unanswerable.' He even applies the same term to Koch's theory of the infective nature of this bacillus. Other observers, however, still entertain doubts on both points, and more particularly the latter, which is in fact very difficult to reconcile with the symptoms of tubercular diseases, and I think it more prudent to suspend our judgment for the present.

As the yellow tubercle degenerates it undergoes one of the two forms of metamorphosis. In most cases it softens and breaks down, and in this degeneration the tissues around are involved. They become disintegrated by low inflammation, and thus a strumous abscess, vomica, or strumous ulcer is formed. It seems that this softening may either commence in the centre of the tubercle, and thence gradually spread to the tissues, or else the inflammation of the latter may involve the destruction of the tubercle. In other cases the tubercles harden as they degenerate, the fluid parts are absorbed, leaving a hard, chalky mass, the cretaceous tubercle, and this change may affect the grey granulation as well as the crude tubercle.[4] In this condition the withered, dried-up mass generally remains innocuous, though sometimes, as Sir J. Paget points out, renewed suppuration is set up around it ('residual

[1] 'Syst. of Surg.' 3rd. ed. vol. i. p. 217.

[2] See Rindfleisch, op. cit. p. 137; Wilson Fox, 'On the Artificial Production of Tubercle;' and Mr. Treves's essay, where beautiful representations of its microscopic structure will be found.

[3] Characteristic illustrations of the naked-eye appearance of crude tubercle will be found in the chapter on DISEASES OF THE BONES.

[4] Rokitansky, who regarded the two kinds of tubercle as independent, speaks of this as the only metamorphosis which the grey granulation undergoes.

abscess'), and thus it is cast out. It is indisputable, however, that cases described as scrofula are often unassociated with any visible deposit of tubercle, and this leads to two questions: 1. Is there anything essentially peculiar in tubercle, or is it merely a form of chronic inflammatory deposit? and, 2. Is the presence of tubercle, or a tendency to its development, a necessary characteristic of scrofula, or is there a distinct class of scrofulous affections in which there is no such tendency? To the first question there is much reason for giving a negative answer. The researches of Drs. A. Clark, Burdon Sanderson, and Wilson Fox and others have shown that by the inoculation of non-tubercular products, or by artificial irritation of the tissues in the lower animals, products indistinguishable from tubercle may be generated; and this doctrine lends strong support to the belief, which experience justifies, and which has been expressed by myself and others,[1] that tuberculosis in the human subject is often the result and not the cause of some exhaustive suppurative lesion which, being described as 'scrofulous,' is often regarded as being dependent on the diathesis, of which, on the contrary, it is itself the cause. If we assume that these experiments made on the lower animals are exactly applicable to man, we shall conclude that the deposit of tubercle is only a more definite form of chronic inflammatory lymph; or, in Dr. C. J. B. Williams's words, that tubercle is 'a degraded condition of the nutritive material from which old textures are removed and new ones formed, and that in its origin it differs from the normal plasma or coagulable lymph, not in *kind* but in *degree* of vitality and capacity of organisation.'

Connection between scrofula and inflammation.

Two forms of struma are spoken of both by Mr. Savory and by Sir W. Jenner. The former speaks thus of the two forms: 'In the first, distinguished as the sanguine or serous, there is a general want of muscular development; for, although the figure may be sometimes plump and full, the limbs are soft and flabby; the skin is fair and thin, showing the blue veins beneath it; the features are very delicate; often a brilliant transparent rosy colour of the cheeks contrasts strongly and strikingly with the surrounding pallor; the eyes, grey or blue, are large and humid, with sluggish pupils, sheltered by long silken lashes; hair fine, blonde, auburn, or red; teeth white and often brittle; there is frequently a fulness of the upper lip and alæ nasi; the ends of the fingers are commonly broad, with convex nails bent over their extremities. Such persons usually possess much energy and sensibility, with elasticity and buoyancy of spirits; they often possess, too, considerable beauty. In this variety, with the same delicacy, the skin and eyes are sometimes dark.

'In the second, distinguished as the phlegmatic or melancholic, the skin, pale or dark, is thick, muddy, and often harsh, the general aspect dull and heavy; hair dark and coarse; the mind is often, but not always, slow and sluggish.

'Children especially, in whom the diathesis is strongly marked, are often distinguished by the narrow and prominent chest, the tumid and prominent abdomen, and the pastelike complexion; the limbs are wasted; the circulation languid; chilblains are common on the extremities; the mucous membranes particularly, and above all of them the digestive, are liable to morbid action; the breath is often sour and fœtid; the tongue is furred, and the papillæ towards the apex red and prominent; the bowels act irregularly, and the evacuations are unusually offensive; the digestion weak, the appetite variable and capricious. In Dr. Todd's opinion "the strumous dyspepsia presents a more characteristic feature of this habit of the body than any physiognomical portrait which has yet

[1] See Wilson Fox, op. cit. pp. 27, 28. Treves, op. cit. p. 218.

been drawn of it." The relation of the digestive organs—the subject upon which Abernethy was so wont to insist—to scrofula was, many years ago, particularly dwelt upon by Lloyd. There is often a strong assumption of age both in character and appearance—in mind and manners they are prematurely old.

'Moreover, persons, and especially children, possessing this diathesis are very subject to certain affections which are regarded by many as manifestations of scrofula; such, for instance, as various eruptions, frequently seen behind the ears; chronic inflammation of the eyelids and conjunctivæ; a certain form of ophthalmia, described as strumous; chronic ulcers of the cornea, &c.' ('Syst. of Surg.,' 2nd ed. vol. i. p. 368).

Sir W. Jenner[1] also divides the strumous diathesis into two forms: 1. Tuberculosis, the leading pathological changes of which are 'fatty degeneration of the liver and kidney, deposits or formations of tubercle and their consequences, inflammation of the serous membranes;' and (2) scrofulosis, the leading pathological tendencies of which are 'inflammation of the mucous membrane, of a peculiar kind; so-called strumous ophthalmia, inflammation of the tarsi, catarrhal inflammation of the mucous membrane of the nose, pharynx, bronchi, stomach, and intestines; inflammation and suppuration of the lymphatic glands on trifling irritation, obstinate diseases of the skin, caries of bone.' I would prefer to substitute for 'caries of bone' 'low inflammation of bones and joints.' Sir W. Jenner attributes to his 'tuberculous' class the same general characters which Mr. Savory specifies as characteristic of the 'sanguine or serous' type of scrofula, and to the 'scrofulous' those which characterise the 'phlegmatic or melancholic' type. No doubt the distinction pointed out by Sir W. Jenner in the tendencies of these two forms or types of scrofula is very generally true, and is important to bear in mind; but I do not think that the two types are so far distinct from each other as to justify us in regarding them as different diathetic conditions. If we do so regard them we should use the word 'struma' as the general term for both the diatheses—the one in which tubercle is met with being called tuberculosis, and the one in which only low inflammations are developed scrofulosis.

From what has gone before it will result clearly that the diagnosis of scrofula cannot be a very decided one. If we agree that tubercle itself, which is the most recognisable anatomical peculiarity of the diathesis, may after all be only a modification of ordinary inflammatory lymph, it cannot surprise us that many cases which one practitioner will denominate as 'strumous' another will regard as examples of chronic inflammation. My own impression, derived from a tolerably extensive experience of cases of so-called 'strumous' disease of joints, is that the great majority of them are usually the results of slight injury, and have no connexion of any sort with any constitutional peculiarity; and I am glad to see this view of the case gaining ground and obtaining the support of eminent practical surgeons. The question, indeed, of the causation and of the prognosis of struma is of the most essential importance when we come to give advice about the treatment of any case diagnosed as 'strumous.' If struma were, as we conceive cancer to be, a general blood-disease, or a tendency in the constitution which has indeed local manifestations, but these only subordinate and, as it were, accidental, the inference is irresistible: that the way to cure the complaint must be by modifying the general disorder, so as to restore the blood or the system to a healthy condition, and that the local conditions are of subordinate importance: and this is the view which has prevailed hitherto, and which is still most extensively

[1] Lectures on Rickets, 'Med. Times and Gaz.' 1860, vol. i. p. 250.

entertained. If, on the contrary, we believe that these strumous diseases are often only instances of common inflammation, and that their relation to the general disease is often that of cause, not that of effect, the motive for curing the disease by surgical interference at the earliest possible moment becomes even stronger than in other cases.

Causes. The causes of scrofula are not very easy to ascertain. It is undoubtedly true that hereditary predisposition plays a very great part in the production of the disease; and it is also, I think, indubitable that it may be caused by any permanent source of malnutrition, such as bad air, insufficient clothing, bad or scanty food, and, I would add, the depressing influence of prolonged suppuration and confinement.

Treatment. The treatment of scrofula must be regulated according to our views of its causes. We cannot act upon the hereditary predisposition further than by enforcing increased caution in the management of such children and young persons as are clearly under its influence, so as to withdraw them as far as may be possible from all the agencies by which the diathesis may be subsequently acquired. When the disease is once developed every condition which can improve the patient's general health must, as far as possible, be secured. Fresh air, moderate exercise, the free action of the skin and bowels, an equable and temperate climate, residence by the seaside, a light, nutritious, unstimulating diet, are, as a general rule, of more importance than medicines, and routine practice is as bad in strumous as in other cases. But there can be no question of the great advantages which are obtained by the judicious administration of cod-liver oil in cases accompanied by emaciation without much dyspepsia, of iron in those where anæmia is a prominent feature, of the syrup of the iodide of iron where the patient is weak, fat, pale, and flabby; of bark and mineral acids in cases where hectic is present; of alkalies in combination with sarsaparilla or milk, along with the moderate use of purgatives, where the secretions are disordered and the digestion faulty. Of these, by far the most important agent in the treatment of scrofula is the cod-liver oil: and, although there is no space in this work for details which more fitly belong to a treatise on therapeutics, yet I must state the most necessary precautions in the use of this drug. The chief objection to its use is the nausea which it produces, especially at first. This is much diminished by commencing with small doses, and by giving the oil on a full stomach—about a quarter of an hour after meals. The full dose for a child would be about two teaspoonfuls, and a tablespoonful for an adult. The taste may be very successfully disguised by floating the oil on orange-wine or tincture of orange, or steel wine; or by mixing it with five or six drops of liq. strychniæ, or a little mineral acid. Often, if the patient can be induced to persevere, his repugnance to the oil will wear off; and as the oil will have to be taken for many months, if it agrees, it is well worth some trouble to establish this tolerance. After a time patients, and particularly children, can take it as an ordinary article of diet, not only without disgust but with pleasure.

I should be sorry if anything which I have said above as to the necessity for eradicating strumous diseases, or diseases reputed strumous, before they permanently impair the health, should mislead the reader into the idea that I advocate hasty operative interference in such cases. They are essentially chronic maladies, whether we regard them as local or constitutional in their origin, and the great majority of them can usually be brought to a successful issue by the mildest treatment, i.e. by laying open any suppurating cavities, dressing exposed surfaces with mildly stimulating lotions or ointments, and

keeping the parts at rest. It is only when prolonged suppuration, or this conjoined with enforced deprivation of air and exercise, is breaking down the health, or when extensive disease of the bony or other structure of the part holds out no hope of natural cure in any reasonable time, that I advocate the removal of the affected organ by excision or amputation; and I think that I have had abundant experience even in my own practice to show that such operations are usually followed by complete and permanent recovery in cases which would by everyone be classed as strumous.[1]

Scrofula is generally a disease of youth; but similar symptoms appear sometimes after middle age, and have lately been more especially described by Sir J. Paget ('Clinical Lectures,' 1875) as 'Senile scrofula.' The disease at this age holds out little prospect of cure, but the general indications of treatment are the same.

[1] See a paper in the 'Lancet,' Feb. 24, 1866, on 'The Sequel in some Cases of Excision and Amputation.'

CHAPTER XIX.

HYSTERIA AND NERVOUS DISEASES.

Definition and pathology of hysteria.

HYSTERIA is a disease which it is very difficult to speak of intelligibly and adequately within the compass of a work like this. Yet, as there is no disease which it does not sometimes simulate, and as the diagnosis between real or, to speak more correctly, organic disease and hysterical, or nervous, affection is of daily importance and of the greatest difficulty in some of the most common surgical complaints, notably those of the spine and joints, it is a condition which cannot be passed over unnoticed in any systematic treatise on surgery. Besides the general remarks in this chapter the reader will find observations on the various special affections in other parts of the book—especially in the chapters on diseases of the JOINTS, the SPINE, and the BREAST.

I have just said that it is more accurate to speak of hysterical disease of a part as contrasted with 'organic' than with 'real' disease; and this is very important. Hysteria is sometimes spoken of as if it were unreal—a mere fancy—perhaps a mere simulation. Such a view is most erroneous, and practice founded on it cannot be successful. The structure of the part is not as a rule in any visible or tangible way affected (though to this rule some exceptions will be pointed out), and there is no danger to life or limb; yet it is impossible to doubt that in many, and I would say most cases, the sensations are as real as those of any other disease, and the patient as anxious to be rid of it as of any other disease. The cause of the disease may be imperceptible to our senses; but it is none the less really present, and its effect is as real as any tumour or other visible product.

Perhaps the best definition of hysteria would be that it is a morbid state in which various symptoms are produced, depending, not on disease of the part affected, but on some condition of the central nervous organs. At the time when the disease was named, it was supposed that this condition of the cerebro-spinal centre was excited by uterine disturbances, and doubtless such disturbances are a frequent exciting cause; but the disease may exist in women whose uterine functions are perfectly normal, and even (though not so often) in men. In these latter cases the origin of the hysterical disturbance is obscure; and in the case of disordered uterine functions, though the cause may be plain enough, its mode of action is utterly unknown.

Hysteria differs from mere delusion, hypochondriasis, or fictitious disease in the fact that the morbid sensations or other symptoms are due to a really existing physical cause—though it is remote from the part affected, and though its detection may be difficult; but it must be allowed that much of delusion and hypochondriacal exaggeration is mixed up with almost all cases of hysteria, and that in many of them the patient wilfully exaggerates many of the symptoms, and very likely feigns others. So that there is a mixture of mental and physical causes in the disease, and its cure must be attempted by treatment addressed to the mind as well as to the body.

'Nervous mimicry,' or 'Neuromimesis.'

Sir James Paget, in a striking series of lectures on this subject,[1] wishes to abolish the old term 'hysteria' altogether, or at least to restrict it to the

[1] 'Clinical Lectures,' pp. 172 et sqq.

mere hysterical convulsive affection. The great class of diseases usually spoken of as hysterical he would call 'neuro-mimetic,' or 'nervous mimicries' of the diseases of the various organs. As a general rule he denies that such diseases have any more connection with the sexual than with any other system of organs in the body. 'In the defective ovarian or uterine functions of certain patients,' he says, 'some see the centre and chief substance of the whole disease; a very mischievous fallacy. Of course the sexual organs appear generally in fault to those who are rarely consulted for the diseases of any other part; but in general practice they are, in a large majority of cases, as healthy as any other parts are, or not more disturbed. The close and multiform relations of the sexual organs with the mind, and with all parts of the nervous system, are enough to make the disorders of these organs dominant in a disorderly nervous constitution; but their relation to "hysteria," or to "neuromimesis," though more intense, is only the same in kind as that of an injured joint or an irritable stomach. All, in their degrees, may be disturbers of a too perturbable nervous system, and equally on every one of them the turbulence of a nervous centre may be directed with undivided force' (op. cit. p. 191).

In fact, nervous or hysterical disease may be excited by anything which makes a strong impression on the nervous system: whether it be sexual disturbance, imagination, bodily injury, mental affection, intense emotion, or any form of disease.

Symptoms and diagnosis.

The usual manifestations of hysteria are the hysterical fit, the globus hystericus, the clavus hystericus, and the diseases resembling those of various organs.

The hysterical fit may be taken as a simulation of epilepsy, though it is usually distinguished from it by characters too obvious to allow of any mistake. It begins generally with rising in the throat, a sense of choking followed by wild, convulsive movements, or rather semi-voluntary movements resembling convulsions, with partial or sometimes complete loss of consciousness, flushed face, eye unusually sensitive to light, the fit ending generally in crying, screaming, and laughing. This is followed by a copious flow of pale urine, very often tympanitis, and generally by profound sleep. Sometimes one fit, or a succession of fits, may last for several hours.

The diagnosis and treatment of hysterical fits is more within the province of the physician than the surgeon. The imperfect insensibility, the absence of any obstruction to respiration, the age and sex of the patient (for true fits hardly ever occur in male hysteria), are the main distinctive marks.[1] No treatment should, as a general rule, be adopted, beyond seeing that the patient does herself no harm by her movements, and limiting the officiousness of bystanders. The rough awakening of a cold douche or some other similar shock is often effective enough in dispelling the fit, and it may occasionally be advisable to use such measures, but ordinarily they do more harm than good.

The globus hystericus is the sensation of some weight or substance which rises from the abdomen into the throat, and this sensation is often followed by the choking and other phenomena of a fit of hysterics. The 'clavus,' or hysterical headache, is a feeling as if a nail were driven into the head. It is a common and troublesome but subordinate feature in the general disease.

The main point, however, in practical surgery is to distinguish those surgical diseases which are hysterical or nervous from the organic affections of the same organs. The joints, the spine, and the breast are the most frequent seat

[1] There are, however, cases in which hysteria and epilepsy seem to be mixed together. See Charcot on 'Hystero-epilepsy,' Lect. xiii. 'New Syd. Soc. Trans.'

of hysterical pain and loss of function;[1] but hysteria may simulate almost any surgical as well as medical disease, and the diagnosis is often rendered the more perplexing by the fact that hysteria very frequently aggravates, and sometimes masks, diseases which really exist; so that in the former case the surgeon, seeing that there is distinct proof of organic disease, is apt to attribute grave importance to what is really only a trifling complaint aggravated by hysterical symptoms; while in the latter case the symptoms of hysteria are so prominent that he overlooks some disease which is really present.

The diagnosis between hysterical and organic affections rests mainly on the following considerations: 1. The pain in hysteria is usually intermitting, irregular, and often much in excess of anything that the visible condition of the parts can account for; it bears no relation to the duration of the disease, and is often obviously affected by emotional causes, and often by the state of the uterine or digestive functions. It differs from true neuralgia in not being generally periodic and in not following the distribution of any nerve, though in many cases hysterical pain is called neuralgia. 2. The *tenderness* which is almost always complained of is diffused, and is as it were *inconsistent*. Thus, for instance, in hysterical disease of the spine the patient will often complain of quite as much pain from a light touch to the skin as from pressure made on the vertebral spines themselves, and it is greatly aggravated by the patient's own attention being directed to it: a patient who, while her attention was fixed on the surgeon's examination, could not bear the lightest touch on the back without complaining of acute pain, will often be hardly sensible of firm pressure, if made at a moment when she is eagerly talking of something else. 3. The *course* of the disease is, however, one of the main elements in the diagnosis, and perhaps of all others the most satisfactory in cases which are otherwise somewhat obscure. We have only too often opportunities of seeing poor women who from unfortunate errors in the diagnosis have been condemned to years of total inactivity for supposed spinal or articular diseases; yet no abscess, no deformity, no material alteration in the shape of the parts has resulted,[2] still less any of the formidable consequences which inflammation would have produced on the parts in the neighbourhood. It is, however, noticed, and not indeed very rarely, that there is some tumefaction round the seat of the disease, often the result, as Sir B. Brodie tells us, of local applications,[3] but also present, I think, in some cases where no friction or blistering has been employed, and then probably the result of congestion. The cause which produces such congestion is no doubt the pain, for the pain in hysterical disease is often (as I have said above) as real as any other pain, and pain easily affects the supply of blood to the part, just as in periodical neuralgia the pulsations of small and previously invisible arteries become plainly perceptible before and during the paroxysm. Sir B. Brodie has noticed that in some hysterical affections of the joints there is a periodical change of temperature, not only of the part but of the whole limb, and he dwells on the value of quinine in such cases (Works, vol. ii. pp. 308, 309). These cases mark still more plainly the affinity between hysteria and neuralgia.

Sir J. Paget has also pointed out the extraordinary variations in *temper-*

[1] Sir B. Brodie says that 'among the higher classes of society at least four-fifths of the female patients who are commonly supposed to labour under disease of the joints labour under hysteria and nothing else.' Sir B. Brodie's collected works, vol. iii. p. 157.

[2] Sir J. Paget gives some striking instances of the perfectly healthy condition of joints after prolonged disuse (op. cit. p. 206).

[3] Op. cit. p. 159.

ature which sometimes occur in 'nervous' maladies. As a general rule the temperature is an important fact in the diagnosis of hysterical affections, since it is far nearer the normal than it would be if the disease were organic; or, if it varies the variations are limited and probably periodic. But these excitable and nervous patients are liable to great disturbances of temperature from slight causes, so that Sir J. Paget says of the temperature, that though 'prudently estimated, it is of the highest value, even in nervous patients; over-estimated, it is more fallacious in them than in any others.' Temperature in hysteria.

These are the chief features in the diagnosis of hysterical affections from their local symptoms. Next the surgeon has to weigh carefully the general symptoms which the patient presents. The complexion of the patient's mind must be studied. The extensive experience of Sir J. Paget has taught him that 'nothing can be more mischievous than a belief that mimicry of organic disease is to be found only or chiefly in the silly, selfish girls among whom it is commonly supposed that hysteria is rife, or almost a natural state.' He believes it to be more true to say that these nervous diseases are seldom to be found in 'patients who have ordinary minds—such minds as we may think average, level, and evenly balanced'—but that in the majority of patients of this class 'there is something notable, bad or good, higher or lower, than the average.' Any observations, however, which may thus be made on the patient's mental constitution can amount to nothing more than a probability, and that not of a very high degree. More tangible evidence may be obtained from the patient's family history—many of the worst instances of hysteria occur in girls brought up by mothers themselves hysterical; from the circumstances of the case—many nervous diseases springing from the contemplation of cases occurring in the family or in public; and from the strange possession which such diseases take of the patient's mind and will. General character of hysterical patients.

With the best attention the surgeon can give to the case, it must be allowed that the diagnosis is often a very doubtful one; and in order to justify a confident opinion in any but the plainest cases repeated examination and observation are essential.

Nothing can be more difficult than the treatment or management of some of these hysterical affections. Too much attention on the part of the surgeon fixes the patient's mind on her ailment, increases its apparent importance in her eyes, and in many cases certainly tends to protract it; on the other hand, roughness or neglect loses her confidence, without which all treatment is nugatory. The moral treatment of hysterical affections is of as much importance as the medical, or more. The first point is to convince the patient that the disease is understood, and its real importance admitted, though not exaggerated. For we must allow that hysteria, though not dangerous to life and seldom threatening the reason, is a very grave disease, and often entails lifelong misery on its victim. When, however, the patient is relieved from the worst anxieties, such as the fear of permanent paralysis, lameness, or other organic disease, the medical or surgical treatment of the case becomes easier. I can hardly do better than transcribe Sir B. Brodie's excellent remarks on the treatment of hysterical joint-affections:— Treatment.

'The recovery of patients labouring under these hysterical affections is often tedious. But much depends on the treatment, moral as well as physical. The sulphate of quinine, preparations of iron, the citrate of quinine and iron, may generally be exhibited with advantage; and these may, according to circumstances, be combined with ammonia or the ammoniated tincture of valerian. In most instances the bowels are in a very torpid state, and active

purgatives are from time to time required. The air of the country, and especially that of the sea-coast, is more favourable to the patient than that of a large town, and while at the seaside she may use cold sea-bathing with advantage, during the summer and early part of the autumn. However, as to constitutional treatment, the best rule that can be laid down is, that the medical attendant should inquire into the state of the general health, and prescribe for the patient according to the circumstances of each individual case. If the menstruation be irregular, deficient, or excessive, he should make it an especial object to restore this function to a healthy condition. . . . To a considerable extent these cases admit of being benefited by medical and surgical treatment; but what I have termed the moral treatment of them is of still greater importance. If a young lady who is thus afflicted be confined to her sofa, her attention being constantly directed to her complaint by the anxious inquiries of her friends, the daily visits of her medical attendant, and the exhibition of a variety of drugs, the symptoms may continue unaltered for many months, and even (and that is by no means an unusual occurrence) for several years. The very opposite course to this should be pursued. Her attention should be as much as possible directed to other objects. She should enter into the society and join the pursuits of persons of her own age. She should be encouraged to use the limb, even though the attempt to do so gives her pain in the first instance, and she should pass a portion of each day in the open air. Under this mode of treatment I have known many cures to be obtained without any medical or surgical treatment whatever.'[1] Sir Benjamin also gives some directions for the local treatment, as applicable to hysterical affections of joints. Such treatment must, of course, vary for different organs. Its general principle is to do as little as possible to fix the patient's attention on the part. Any plaster, bandage, or other application which keeps the part comfortably warm and prevents the patient from handling or looking at it, may do good. Sometimes pain suddenly inflicted, as by the moxa or a galvanic shock, effects a wonderful cure—similar to Sir B. Brodie's case, in which a young lady was cured of a hysterical pain in the hip by a fall from a donkey. And there are cases (as he also mentions) in which a sudden mental impression, such as a sudden call to 'rise up and walk,' has produced the desired result. But as a general rule little is required in the way of local applications beyond what is necessary to maintain the natural warmth of the part. Warm bathing is often of much service; and so is galvanism, if properly applied. Cold, Sir J. Paget says, almost always does harm.

Narcotics and opiates are to be avoided by all means if possible. They are generally unnecessary and often most injurious, and should only be used when it is impossible to avoid it; and this impossibility should not be hastily admitted. I have often known patients habituated to the use of opium for nervous pain who could by no means sleep without pills, but who slept quite as well when they were made of bread as of opium. At the same time the patients must have quiet sleep; and although exercise is to be enforced, yet long periods of rest afterwards are needed.

[1] Sir B. Brodie's Works, vol. ii. p. 309.

CHAPTER XX.

GONORRHŒA AND SYPHILIS.

THE diseases which owe their origin to sexual intercourse are gonorrhœa and syphilis; the former almost exclusively a local disease, yet which has, as we shall see, its constitutional manifestations also; the latter usually also entirely local, yet in its constitutional form one of the most insidious and abiding infections to which the human body is liable.

Gonorrhœa in the male.

Gonorrhœa differs widely in the two sexes. It is so much slighter a disease in women that the descriptions of it are always taken from the male sex. Four stages of the complaint are described—the premonitory, the inflammatory, the stage of decline, and that of gleet.

The premonitory stage.

The first lasts often only a few hours, sometimes as much as two days, and commences generally from two to five days after intercourse—rarely later. It is marked by a slight itching and a little tumefaction of the lips of the meatus, and possibly some slight discharge, just enough to make the lips of the urethra stick together.

The inflammatory stage.

This is succeeded by the second stage, in which there is high inflammation of the lips of the urethra, and sometimes also of the prepuce, causing phimosis, with creamy, greenish, purulent discharge, tenderness to pressure along the urethra, scalding in making water, which is sometimes so painful as to occasion much spasm and difficulty in doing so, even temporary retention; a sensation of weight in the perinæum, and painful erections, especially at night. Sometimes *chordee* is present, i.e. an effusion of lymph into the corpus spongiosum, which prevents distension of its cells in erection, causing the distended corpora cavernosa to bend over it, and thus giving the organ a curved shape as if bound down by a cord. This, however, is rare by comparison with the occurrence of mere painful erections, and still rarer are the cases in which the effusion takes place into the corpus cavernosum, causing the penis to curve to one side in erection.

The inflammatory stage lasts from one to three weeks. Its symptoms are due to acute inflammation and sometimes ulceration of the mucous membrane lining the urethra, usually situated around the fossa navicularis and in or about the bulb,[1] though it seems that any part or the whole of the canal may be affected.

The stage of decline.

The third stage (which is, in fact, a part of the second) is marked by the recession of all the symptoms, the scalding subsiding, the discharge becoming more and more mucous, and the disease then either disappearing altogether or passing into the fourth stage, that of *gleet*, which is a mere thin, watery discharge, unaccompanied by any symptoms except, perhaps, a little tenderness to pressure over the affected part of the urethra, the discharge proceeding from localised inflammation, or, as some think, probably ulceration of the mucous lining of the fossa navicularis, or bulb.

Gleet.

Complications of gonorrhœa.

The common complications of gonorrhœa are as follows:—

Abscess may form in the areolar tissue of the penis or scrotum; or, as is

[1] See a preparation in St. George's Hospital Museum, Ser. xii. No. 61.

Lacunar abscess.

much more common, in one of the lacunæ of the urethra. Such 'lacunar abscess' also occurs from other causes, as from riding on a wet saddle or inflammation behind a stricture. It forms a small, hard, painful swelling in the course of the urethra, which often occasions considerable difficulty in micturition, amounting even to complete retention. For its treatment it is usually sufficient to apply a poultice and pass a catheter when necessary to relieve retention, in doing which the abscess is often ruptured and the complication disappears. If there is much pain there can be no objection to making a puncture. The abscess bursts generally into the urethra; if through the skin fistula hardly ever results, for the opening into the urethra either does not exist or closes spontaneously.

Balanitis.

Balanitis is less a complication than a form of gonorrhœa. We have noticed that in ordinary gonorrhœa the prepuce may be so much swollen as to cause phimosis. Sometimes this inflammation and swelling of the prepuce and the surface of the glans is the whole of the disease, the interior of the urethra being unaffected, or only its lips inflamed. The absence of scalding in making water will lead the surgeon to the belief that he has a case of pure balanitis to deal with, but he can hardly be certain until the inflammation of the prepuce has subsided sufficiently to allow of the examination of the meatus.

Phimosis.

Again, inflammation of the prepuce leading to phimosis is so common with syphilitic sores, that often cases which have been diagnosed as balanitis turn out really to be syphilitic. Hence a good deal of reserve in forming and expressing an opinion is desirable. Cases of veritable balanitis are to be treated by keeping the penis raised and washing out the prepuce frequently with injections of cold water or some astringent, as lime-water or weak solution of nitrate of silver. The parts may be dusted at night with calomel in fine powder mixed with magnesia, to be washed away with the injection in the morning. The mere phimosis produced in ordinary cases by gonorrhœa seldom requires any operation, as it will subside on the recession of the disease; but in cases of gonorrhœa affecting persons who have congenital phimosis it is often necessary to operate.

Paraphimosis.

Paraphimosis is a much more painful affection than phimosis, of which it is a sequel. The phimosed and inflamed prepuce has been forcibly drawn behind the corona glandis, and has there swelled and inflamed still more, producing great constriction and consequent swelling of the glans, with grievous pain; and, if unrelieved, leading to ulceration where the penis is constricted by the prepuce, and to more or less extensive gangrene of the constricted glans penis. A paraphimosis can always be reduced, if seen before adhesion has taken place between the constricting prepuce and the tissues beneath. The fore and middle fingers of the two hands should be crossed on each other around the penis, which is thus firmly grasped, and the prepuce pulled forwards, while with the two thumbs the blood is kneaded out of the glans and the latter pushed back. As this is acutely painful it is usual to administer an anæsthetic. If the paraphimosis be irreducible, the strangulation must be liberated by cutting freely through the constricted prepuce on either side of the penis, so as neither to endanger the vessels on the dorsum nor the urethra on the lower surface of the organ. After all swelling has subsided the prepuce, if too long, must be circumcised.

Spasms and hæmaturia.

Another complication of gonorrhœa is severe spasm in making water, sometimes complicated with hæmorrhage from the urethra, and then very probably depending on ulceration of the lining membrane. This is more annoying and

alarming to the patient than really dangerous. The spasms will subside by very free use of the warm hipbath (in which the patient can generally pass water easily) and by rest, abstinence from any irritating medicines or applications, bland drinks, and opium. The hæmorrhage is never really formidable, but if it is at all copious the acetate of lead or Ruspini's styptic may be given internally, and the patient kept in bed, with ice applied to the perinæum. The hæmorrhage occurs most frequently in connection with chordee, and the treatment which obviates the latter condition will stop it. The most effectual treatment for chordee is to procure very sound sleep, by means of bromide of potassium and opium taken immediately before going to bed. The patient should also be kept slightly below par by low diet and small doses of tartar emetic. When the chordee comes on some patients derive relief by the application of sudden cold to the penis, as by putting it against the stone or metal of the chimney-piece, but to sit in warm or hot water is generally much more effectual and grateful.

Chordee.

Bubo is a common complication, and sometimes the lymphatics of the penis are themselves inflamed and stiffened, whereby a difficulty in erection is produced something like chordee. In these cases mercurial ointment in small quantities should be rubbed in. The inflamed inguinal glands should be treated at first by complete rest, and then, if hard and indolent, by tinct. of iodine, or by blistering. The latter is an excellent remedy in chronic bubo, frequently procuring the absorption of the swelling, and when it does not do so, usually causing it to suppurate. When suppuration is decided the abscess should be laid open pretty freely. Some surgeons lay great stress on making the opening perpendicular instead of parallel to Poupart's ligament, thinking that the movements of the thigh and body will have less tendency to keep the wound open. I cannot say, however, that I attach much importance to the direction of the incision, provided it passes pretty completely through the cavity.

Bubo.

Gonorrhœa is sometimes followed by an eruption of red papules. This is usually the consequence of the administration of capivi to a patient whose stomach will not bear it, and is hence called the 'capivi rash;' but a similar rash may also, though rarely, be found when gonorrhœa is complicated with other forms of gastric irritation not caused by capivi. The eruption being papular resembles lichen more than any other form of skin-disease, but sometimes it is merely a rash, like roseola. In other cases it is mixed with wheals of urticaria. The treatment consists in leaving off capivi or anything else which may be disagreeing with the stomach, free purging, and the correction of the secretions by alkalies with mercury.

Gonorrhœal and capivi rash.

Gonorrhœal rheumatism, or synovitis, is a painful and often a very intractable disease. Its pathology is still a matter of dispute; but there seems now a very general agreement that it depends in some way or other on the irritation and discharge in the urethra, and that its cure must be sought for in the cure of the urethral discharge; and this lends at any rate considerable probability to Mr. Barwell's[1] speculation that the disease may really be a form of pyæmia or blood-poisoning, the starting-point of which is inflammation of the veins around the urethra or prostate gland. It is often noticed that the inflammation will persist so long as the discharge persists, and even so long as there is any tenderness in the affected portion of the urethra, but subsides at once when the urethra has become perfectly healthy. Such rheumatism is not confined entirely to gonorrhœal inflammation of the urethra, but is sometimes

Gonorrhœal rheumatism.

[1] 'On Diseases of the Joints,' 1861, p. 101.

though rarely, found after urethritis from other causes.[1] It is far rarer in women than men, and this corresponds with the general immunity of the female urethra in gonorrhœa, though cases of gonorrhœal rheumatism have been recorded in females. It almost always affects the knee; other joints may also be implicated, but I can hardly recollect a case in which the knee was not the principal seat of the disease. The pain is not usually acute, but it is constant, worse at night, and accompanied by considerable synovial effusion. This form of rheumatism is often followed by ankylosis.

'There is also,' says Mr. Bond, 'a most common and characteristic complication affecting the eyes, and this is a congestion of the sclerotic. The conjunctiva is sometimes slightly congested, and the caruncule red and injected; but the great peculiarity is the congestion of the sclerotic vessels which are seen radiating around the cornea.'

Treatment of gonorrhœal rheumatism.

The patients are usually pale anæmic men, in whom discharges are very liable to occur and very difficult to cure; and the connection of the rheumatism with the gleet is sometimes conclusively proved by the recurrence of the former when any accidental cause (of which the most frequent is sexual intercourse) has produced a renewal of the latter.

Accordingly the first indication of treatment is to cure the discharge. If a bougie or catheter be passed it will almost always be found that there is considerable spasm, and that the urethra bleeds very readily. Under the influence of instruments gradually increasing in size the irritability of the urethra will often subside and the gleet disappear. If not, astringent and sedative injections must be resorted to. Mr. Bond speaks highly of an injection made with half a drachm of tannin in six ounces of cold water, with two drachms of opium added. A fine precipitate is formed. The injection is to be well shaken just before use, and this precipitate will adhere to the walls of the urethra, making the astringent and sedative action of the application more permanent than that of a merely fluid injection can be. The general health must be carefully attended to; steel, quinine, strychnia, bark, or any other tonic which may be preferred, must be administered, with good diet and a sufficient supply of stimulants. At the same time the digestion and the state of the urine must be carefully attended to.

Iodide of potassium is often administered in this disease, and when the patient is in robust health and the drug agrees with him I have seen very good results from it; but I agree with Mr. Bond in dissuading its employment in cachectic persons.

Locally, some mild counter-irritant generally answers best, combined with gentle pressure when the pain has subsided. Scott's bandage is a very good application in the last stages of the complaint. In a case recently under my care, in which the effusion was considerable and the symptoms unusually severe, I emptied the joint by means of the aspirator with excellent results.

Other complications.

The other complications of gonorrhœa are inflammation and abscess of the prostate, orchitis or epididymitis, and gonorrhœal ophthalmia. These will be found treated of in the chapters on diseases of the urinary organs, of the testicle, and of the eye respectively.

Treatment of gonorrhœa.

The treatment of gonorrhœa is often very difficult, and the more so the more virulent is the affection and the more cachectic the patient. With regard to the former particular, there can be no doubt that inflammation of the male urethra follows sexual intercourse with women who have no specific

[1] Hence it is sometimes called 'urethral rheumatism.' See a very interesting paper by Mr. Bond, 'Lancet,' March 23, 1872.

disease, but who are suffering from leucorrhœa, or who have some ulceration of the os uteri, or who are menstruating ;[1] but such affections, if they deserve the name of gonorrhœa, are far less acute under ordinary circumstances than the disease which is excited by true gonorrhœal pus, and they come on with less premonitory symptoms.

In the early stage gonorrhœa may doubtless be often cut short by repeated injections, for which purpose either mere water may be used, cold or tepid, or a weak solution of acetate of lead or sulphate of zinc, the object being merely to wash out the discharge. The patient must be carefully instructed in the method of injecting, and the process be repeated every hour while he is awake.

At the same time demulcent drinks, low diet, slight purging, and complete rest, in bed if possible, are to be ordered.

Some practitioners use stronger injections, such as arg. nit. in solution, but they are more dangerous and not more efficient. The first effect of these strong injections is to increase the inflammation, so that after about two days there will be a good deal of discharge, and perhaps a little blood. Then the injection is to be stopped, in the hope that the discharge will subside and the patient recover under the same precautions about rest and diet as before.

In the inflammatory stage the treatment should not certainly at first be too active. The patient seems to me to recover more speedily if treated at first by demulcents, rest, frequent warm bathing, warmth or poultices to the perinæum, with leeches there if the symptoms be very urgent, and low diet with much bland fluid, than where any specific medicines are ordered. Injections other than those of tepid water should not be used while there is much scalding and inflammation. The meatus must be kept clean by frequent ablutions, and the penis should not be too closely covered. When the acute symptoms are subsiding copaiba is often most useful, and in some cases indispensable to the cure of the disease. I have known cases in which the discharge would at once recur when the drug was omitted, though in other respects the treatment and all other circumstances were the same. But there are cases in which it does no good, and some in which it does much harm, upsetting the digestion, causing rash, and probably irritating the urethra, and so predisposing to gleet and other complications. It is best prescribed either in the form of an emulsion or in doses of ʒss or ʒj, mixed with ♏xv of dilute sulphuric acid in infusion of roses. The common capsules disguise the taste of the drug, and are in that respect most convenient; but they are not so much to be relied upon. Cubebs appears to be much less efficacious, and, indeed, by itself nearly inert as far as the *cure* of the disease goes ; but some practitioners think that an addition of about ten drops of the tincture of cubebs increases the efficacy of the copaiba.[2]

[1] It is on this account that it is commonly said that gonorrhœa is more frequent in men than in women.

[2] The treatment of gonorrhœa in private or hospital out-patient practice is necessarily somewhat unsatisfactory, since it is hardly possible to insist on the complete rest and abstinence from all forms of excitement which is so necessary to rapid recovery. In civil hospitals persons affected with gonorrhœa are seldom admitted as in-patients. But in military hospitals the disease is constantly under treatment, and cure is, as a rule, speedily and easily obtained. I accordingly requested my friend Mr. E. Venning, then Assist.-Surgeon to the 1st Life Guards, to sketch out for me the plan which he usually adopted, and which may be taken as agreeing in the main with that followed in other regimental hospitals. Mr. Venning speaks as follows: 'In slight cases, in which the urethral discharge is not very profuse and there is not great inflammatory action present, I simply give the patient a warm bath, and have him placed in bed and keep him in the horizontal position. I generally order a mild purgative to be administered, and direct him to use an injection consisting of zinci

Treatment of gleet.

The treatment of gleet is often even more tedious and difficult than that of gonorrhœa. The patient is usually weak, sallow, and cachectic, and depletion does not agree with him. But neither does any copious indulgence in stimulants. Moderate allowances of meat, wine, and exercise are usually to be recommended. Any defect of the general health must be discovered, and, as far as may be, corrected, and some tonic, such as steel, strychnia, or bark, will generally prove beneficial. Local treatment must be directed in the first instance to discover whether there is any contraction (spasmodic or other) of the urethra; and often the constant passage of bougies, increasing in size until the urethra is distended to its extreme limit, will cure the complaint; or else the use of injections, or touching any tender spot of the urethra with the porte caustique, or with a solution of perchloride of iron, will cure the discharge. But often it will not subside till the patient has undergone a thorough change of climate and way of life.

Gonorrhœa in women.

In females gonorrhœa is a much less severe complaint than in males. It affects chiefly the vulva and vagina, rarely the urethra or bladder. It is difficult or impossible to distinguish aggravated leucorrhœa from mild forms of gonorrhœa; nor is it of much importance, since, doubtless, such leucorrhœa will excite gonorrhœa in the male. Prostitutes are especially liable to leucorrhœa in consequence of the constant excitement of the generative organs; but the certifying surgeons under the Contagious Diseases Acts only think it necessary to seclude those in whom the discharge is purulent. There is a form of purulent discharge from the vulva pretty often seen in young children—the

Leucorrhœa infantum.

leucorrhœa infantum—which was at one time confounded with gonorrhœa, and was believed to be due to impure connection; but this, in the great majority of cases, is an unfounded suspicion. In some cases no doubt young children are affected with ordinary gonorrhœa, but in such instances marks of violence about the vulva will exist, and will show that forcible entrance has been attempted; or possibly, if the case be seen soon after the rape, spermatozoa may be discovered in the vulva. Usually, however, this discharge originates either from dirt or from some cause difficult to discover. Many of the children certainly suffer from worms. Attention to the general health, strict cleanliness, frequent washing out of the vagina and the use of a tent steeped in some astringent lotion, will effect a cure.

Symptoms of gonorrhœa in females.

Gonorrhœa in the female causes acute inflammation of the vagina and vulva, frequently accompanied by swelling of the nymphæ, which protrude

sulph. gr. iv., glycerine ʒss, morph. acetat. gr. ¼, aquæ destil. ad ʒvj. To be injected every hour or two, provided no pain is caused. The diet to be light and non-stimulating. In severe cases, where there is much inflammatory action, shown by a profuse, thick, yellow discharge, and accompanied with great urethral irritation during micturition, which latter is generally very frequent, and when chordee causes great distress, I also commence treatment with a warm bath and a brisk purge, and order a saline demulcent mixture (occasionally combining antimony with it) to be given every four hours, and I give directions for the urethra to be constantly washed out with tepid water. In addition to this I order a suppository containing morphia and henbane to be administered at night to relieve the chordee. The diet to be light and non-stimulating. Perfect rest in bed to be maintained. When the most acute symptoms have subsided I then prescribe a mixture containing oil of sandal-wood, mucilage of acacia, and tinct. of orange-peel twice a day, and an injection consisting of zinci sulpho-carbolat. ʒss, morph. acet. gr. ½, aquæ destil. ad ʒviij. To be used every two hours. If any pain is caused by this, to dilute it with distilled water. If the discharge does not rapidly decrease under this treatment I increase the diet at once, as I have often found that discharge is kept up by the patient becoming lowered in strength by the constant drain on the system; and that the administration of wine in the form of claret, with a generous diet, has been attended with excellent results.'

beyond the labia. The discharge is sometimes very profuse, and there are often excoriations in various parts of the vagina; the labia are frequently much swollen, and abscess often forms there. Hence there is much pain in walking and in sexual intercourse. Sometimes the inflammation attacks the urethra, and then usually causes more or less cystitis; occasionally it spreads backwards as far as the os or cervix uteri, and it seems certain that peritonitis may be caused by its passage inwards, and that a form of inflammation sometimes attacks the ovary analogous to the orchitis of the other sex. The acuter attacks of gonorrhœa are painful, but there is rarely any scalding in micturition, as in men. The complications also are much rarer than in the male. Ovaritis would cause pain, swelling, and tenderness in the iliac fossa, with nausea and fever, and the pain would be aggravated by coughing or other exertion of the abdominal muscles. Rest, free leeching of the abdomen, salines, and opium constitute the appropriate treatment.

Complications of gonorrhœa in the female.

Bubo is not so common as in males. Its treatment is the same.

Abscess of the labium is the most common complication, and it sometimes extends to a great distance. I once had a patient who was sent into the hospital for supposed fistula in ano. The opening was a good way behind the anus, and on probing it I found that it passed forwards, and then on examination of the vulva the case resolved itself into one of gonorrhœa with labial abscess.

Vegetations and mucous patches around the labia and anus are very common, particularly in prostitutes. Any discharge which may be present being cured, these vegetations will either subside of themselves or may be treated with the strong liquor plumbi, or snipped off, or tied with an elastic ligature. When they are very numerous and large it is better to remove them freely on a level with the skin and apply the actual cautery to any bleeding point.

Treatment of gonorrhœa in the female.

The treatment of gonorrhœa in the female is very much easier than in the male, provided that the patient is properly under control. In hospital out-patients the disease is often very intractable, because the patient will not take care of herself nor abstain from sexual intercourse; but with perfect rest, perfect cleanliness, and frequent copious injections, the disease will, in almost all cases, soon subside. The injection, or rather the washing out of the vagina, should be managed by means of large quantities of some weak lotion, such as Goulard, or a solution of sulphate of zinc, two grains to the ounce, pumped in, while the patient is recumbent, by an endless syringe (Evory Kennedy's), and allowed to run out. If any ulceration can be seen it may be touched with caustic through the speculum. Lint steeped in the lotion should be placed between the labia to avoid their mutual contact, or the vagina plugged with a pessary of tannin. While the inflammation is acute, salines and low diet must be ordered, but 'the exhibition of specifics (copaiba or cubebs) in the gonorrhœa of women is perfectly futile, unless the urethra be affected, and even then they seem to be productive of little if any benefit.' (Lee.)

SYPHILIS.

Syphilis is defined as being a specific disease produced by the contagion of the same disease in another person, and characterised (*a*) in its primary form by the appearance on the part inoculated of one of two different kinds of sore (or *chancre*); and (*b*), in its secondary or constitutional form, by various eruptions

on the skin, by sore-throat, affections of the eye, the glands, the bones, and almost every other tissue of the body.

The contagion is always conveyed by direct inoculation, generally, of course, in sexual intercourse, but accidentally in other forms of personal contact, as when a surgeon inoculates a wound in his finger by touching a syphilitic sore, or a wet nurse inoculates a crack on her breast by suckling a syphilitic infant, or when the syphilitic virus is purposely inoculated for medicinal or experimental purposes.

In this definition all diseases excited by sexual intercourse which are not gonorrhœal but are marked by the appearance of a chancre are classed as syphilitic; but there is a striking and radical difference between the two kinds of chancre, viz. that in one kind the disease is local merely, never affecting the constitution, and followed therefore by complete recovery as soon as the local mischief is healed, while the other kind constitutes the most obstinate infection to which the human subject is liable, remaining during the whole of the person's lifetime (in the more obstinate and inveterate cases, which, however, are happily rare) as a constant source of trouble and danger, breaking out after long intervals of health in one part of the body after another, and being transmitted through the blood of the mother or the semen of the father from one generation to another.

Varieties of nomenclature.

Hence some pathologists separate these two forms from each other in nomenclature as they are separated in practice—calling the non-constitutional forms of chancre 'venereal disease,' or 'the non-infecting or chancroid sore,' while they restrict the name of 'syphilis' to the constitutional disease, calling it also 'true chancre,' or 'infecting sore.' But without entering on the controversy whether there is one kind of syphilitic poison or two, I think it sufficient to say that the definition adopted in the following pages is the most common, and has the advantage of involving no theory, but being a plain statement of everyday facts.

Local syphilis, or the non-infecting sores. 1. The common soft chancre.

To commence with the local form of syphilis. This exhibits itself in three principal varieties: 1. The common soft chancre unaccompanied by bubo; 'suppurative syphilitic inflammation,' as Mr. H. Lee calls it. The sore appears four or five days after connection, and begins to suppurate at once; it looks as if a piece had been chipped or punched out of the part; its borders are defined and often slightly undermined, its base sometimes thickened by the inflammation of the tissues under it; but this hardness is different in character from that of the hard or Hunterian chancre, as will be presently pointed out. The sore heals with no remaining induration in three or four weeks. The absorbents and glands are unaffected. In many cases there are two or more sores at the same time. Sometimes the orifice of the prepuce is surrounded by a ring of radiating cracks or sores.

The term 'phlegmonoid' is applied to a variety of soft sore in which, in consequence of the more active nature of the inflammation, there is greater induration and a more raised margin, and in which the sore is slower to heal.

2. The sore with suppurating bubo.

2. When the soft sore is accompanied by a suppurating bubo, or in those rare cases in which the inguinal glands are enlarged and suppurate without any breach of surface on the genitals, the case is classed by Mr. Lee under the name of 'ulcerative syphilitic inflammation.' The sore is ragged and worm-eaten; the absorbents are often affected as well as the glands, and specific abscesses are sometimes though rarely formed in the course of the absorbent vessel. It is found by experiment that matter taken from any part of this course as far as the gland is contagious. Yet the contagion is destroyed at the gland, so that

no part of the body beyond the gland is affected, nor is the blood contaminated.[1]

The treatment of these forms of syphilis is expectant only. If the patient be haunted by nervous feelings produced by the sore, or if from any circumstance it is of especial moment to him to hasten its cure, this may perhaps be effected by destroying its surface with some strong caustic, such as potassa fusa, or the acid nitrate of mercury; but such treatment being entirely superfluous should only be adopted at the express instance of the patient.[2] All that is necessary is to keep the part clean, to apply some slight stimulant, such as the black or red wash, to poultice the bubo and open it as soon as it suppurates, and to enforce abstinence from sexual intercourse. Mr. Berkeley Hill speaks strongly in favour of Iodoform applied to the surface of the sore, either in powder or ethereal solution, if the sore is not inflamed ('Brit. Med. Journ.' Jan. 26, 1878).

Syphilitic phimosis.

When such sores are inflamed from any cause, the inflammation may propagate itself to the prepuce, causing phimosis; and if the surgeon has not seen the case before this has taken place he may be uncertain whether the case is one of balanitis, soft sore, or hard sore, for hard sores when inflamed may suppurate freely. The safest plan on the whole is to wait until, under the measures recommended in gonorrhœal phimosis (see p. 874), the swelling has been subdued and the glans can be uncovered and thoroughly examined. If necessary, however, it is justifiable to divide the prepuce, and so uncover the sore and expose it to treatment, since sometimes it can hardly be got to heal otherwise. I have often done this with impunity, and Dr. Humphry speaks of having done it a great number of times with no bad results. Still it must be allowed that there is some risk (particularly if the sore below is of the infecting variety) that the whole wound will become one large V-shaped chancre, as I saw happen in one instance in which the patient had had the prepuce slit up before he came under my care. Some idea can occasionally be formed of the existence and of the character of a sore by feeling the glans through the prepuce, but very often the latter is too much swollen to permit this.

3. Sloughing sores.

3. The third form of local chancre is the gangrenous—a far more serious affection than either of the others, but usually resembling them in not being followed by secondary symptoms.[3] It is subdivided into the sloughing and the phagedænic form of sore. In the former the gangrene is of the moist variety, spreading sometimes with alarming rapidity. It is more commonly seen in this country in women, who are almost always prostitutes, broken down by want and debauchery; but in military practice it shows itself in soldiers, whose circumstances have been somewhat similar, as a kind of epidemic affection, which sometimes assumes formidable proportions. It

[1] From this fact Mr. Lee is led to question the office of the absorbents and glands in the infecting form of syphilis in conveying the virus into the system, a function which he is inclined to attribute to the veins.

[2] This is of course a matter of opinion—I give my own in the text—but would warn the reader that the opinion of many eminent surgeons is in favour of the prompt destruction of soft sores. The objection that has been made to the caustic treatment of soft sores is that the cure is not always thereby hastened, as on the separation of the slough the exposed surface takes on a chancroid action. Dr. Piffard of New York says that a more rapid cure can be obtained by destroying the sore or sores with the galvanic cautery at a white heat. This is so little painful that he regards an anæsthetic as unnecessary, though to women or in private practice nitrous oxide may be desirable. ('N. Y. Arch. of Clin. Surg.,' i. 178.)

[3] Phagedæna may follow on the Hunterian chancre; but, as a general rule, sloughing sores are, in my opinion, non-infecting. Mr. Hutchinson, however, teaches the reverse.

occurs either primarily—the sore sloughing as soon as formed—or a previously-formed sore takes on a sloughing action. It seems often implanted, as from one labium to the other, or from the glans to the prepuce. It does not affect the absorbents (though it may attack a bubo), nor is it followed by secondary symptoms; but it often spreads to a dreadful extent, and may even prove fatal by exhaustion or by hæmorrhage in the separation of the sloughs.

The other form is the phagedænic, and this also may occur either primarily or secondarily.[1] It is inoculable. Sometimes, when a bubo has existed, this also becomes phagedænic; otherwise this form does not affect the absorbents.

Sloughing sores are best treated by poulticing (with charcoal or yeast, if the sore be very foul), free doses of opium, diffusible and alcoholic stimulants, and very nutritious diet. In the phagedænic form the surface of the sore may be destroyed by nitric acid, if the sloughing action does not extend deeply; otherwise lotions of nitric acid or of potassio-tartrate of iron, or of bark and myrrh, or of carbolic acid, should be applied, and a regimen similar to the above ordered.

The constitutional or infecting form of syphilis.

The constitutional form of syphilis, *syphilis proper*, or *infecting sore*, is distinguished by the occurrence on the genital organs, or other part primarily affected, of a peculiar form of chancre, the 'hard' or 'Hunterian' chancre, which is characterised by the occurrence of adhesive inflammation in the neighbourhood of the ulcer, producing a peculiar induration, and by a chronic engorgement of the lymphatic glands, which are very slow to suppurate even on irritation, and which under ordinary circumstances remain in an indolent condition for an indefinite time, forming a bunch of hard knobs under the skin ('amygdaloid glands'). The chancre begins at a variable time after exposure to contagion. It may be as early as three or five days, but well-authenticated instances are on record in which several weeks have elapsed.[2] Slight itching is first noticed at the part, then redness, and a small vesicle forms, which soon cracks, and induration shows itself at the base of the crack; the sore spreads and becomes excavated and glazed, with little or no granulation on its surface. Its natural secretion, if examined microscopically, is found not to be purulent, but to contain only a little granular matter, though the sore can be made to suppurate by the friction of the clothes or by irritating applications. The hardness at the base of the ulcer from which the sore takes its usual appellation is of a peculiar kind, different from that which is found at the base of a phlegmonoid soft sore, in this, that in the Hunterian chancre the hardening feels as if due to a layer of parchment or other hard material let into the tissues, that is to say, it is of limited thickness, and abruptly ceases where the healthy tissues commence; while the hardness at the base of a phlegmonoid sore, being due to the infiltration of lymph from common inflammation of the cellular tissue, is of a much less defined character, extends farther, and fades away much more gradually into the healthy tissues. It must be remembered that the nature of the tissues in which the sore is seated will much affect the amount of hardness around it. Thus a sore will be much less indurated on the glans penis than on the prepuce, in consequence of the absence of any cellular membrane in the former.

The 'hard' or 'Hunterian' chancre.

Diagnosis between the two forms of sore.

[1] The primary phagedænic sore must of course be carefully distinguished from phagedæna affecting a secondary syphilitic ulcer, such as are sometimes found on the genital organs.

[2] Lancereaux gives a table of ten cases of inoculation with matter from secondary sores. The mean period of incubation was twenty-eight days. When the disease is derived from a primary sore the period of incubation is probably much shorter, but in two cases related by him it was eighteen days.

The nature of the secretions is also much relied on as a test between the infecting (adhesive) and the non-infecting (suppurative) form of sore. Mr. Lee says: 'If the secretion from an uncomplicated infecting sore be placed on a piece of glass, and a drop of dilute nitric acid be added, the microscopic appearances will be found to be very different from those characteristic of the secretion from a naturally suppurating sore. The secretion from an infecting chancre is not pus; it consists of epithelial débris, of globules of lymph more or less perfectly formed, or of these same products undergoing disintegration, and of serum more or less turbid. These different products may often be found matted together, mixed occasionally with a few pus-cells;' while of the secretion from the soft sore he says that 'it consists of well-formed pus; and each globule is of nearly the same size and distinct from the rest. If, in any doubtful case, some of the secretion from a sore be mixed with a little dilute acetic acid and placed under the microscope, the distinctive character of the pus-nuclei will be seen.'[1] The annexed figures, borrowed from Mr. Lee's work, will render the distinction obvious. But Mr. Lee takes care to explain that this distinction depends for its clearness on the absence of irritation of the sore. And I think I may add that both of these tests are more applicable to the male than the female sex, for in women chancres presenting the characteristic induration are indisputably rare, and suppuration is far more easily excited in a chancre within the vulva than in one of the penis. Another very reliable test is the nature of the accompanying bubo, the indolent hard bubo which is caused by the infecting sore being easily distinguished from the irritable, inflammatory, and rapidly suppurating bubo of local syphilis. Again, the bubo of soft chancre usually affects a single gland, while the indolent bubo consists more commonly of several. The character of the bubo seems to me, taken by itself, much more reliable than either of the other diagnostic marks between the two forms of chancre. But it is of course safer to take all the tests at the same time. I have not enumerated among these diagnostic symptoms the inoculability of the secretion on the patient's own body, since eminent pathologists differ as to the value of that test. The reader is referred, on this head, to the section which treats of 'Syphilisation.' By one or other or all of these tests an infecting can usually be distinguished from a non-infecting sore; but it is undeniable that mistakes are tolerably often made. The experience of civil practitioners is hardly available for showing what the proportion of such mistakes is, since a surgeon, as a general rule, has not a sufficient number of his patients under observation for a series of years to tell how many mistakes he may really have made; but in military practice it is otherwise. An army surgeon has the means of ascertaining the medical history of most of his men for many years together: and this was the case under the system of long service still more than it is at present, and it appears to result from the records of military hospitals that in about nine-tenths of the cases the diagnosis has been accurate. Military surgeons are so much occupied with the



A B

Fig. 178. A. Secretion from local suppurating sore, treated with dilute acetic acid and magnified 700 diams. B. Secretion from indurated sore, examined in the same way as A.—From Mr. H. Lee's Essay on Syphilis, 'Syst. of Surg.' vol. iii. 3rd ed.

[1] 'Syst. of Surg.' 3rd ed. vol. iii. pp. 317 and 315.

diagnosis and treatment of syphilis that we can hardly expect better results from the practice of civil surgeons.

The causes of mistaken diagnosis between the infecting and non-infecting forms of syphilis seem chiefly two: 1. That both forms may co-exist, i.e. a previously existing soft sore may, in a second connexion, be inoculated with the virus of an infecting chancre, and the surgeon, deceived by the evidences of local syphilis, may overlook those of the constitutional disease, or the latter may be still dormant and undiscoverable;[1] or (2) the hard sore, and even in some cases the hard bubo, may by irritation be made to suppurate, and thus be taken for a soft sore or an inflammatory bubo. The above observations apply to the mistake of taking an infecting for a non-infecting chancre, and to the refutation of that mistake by the appearance of secondary syphilis. How often a soft sore is pronounced to be a Hunterian or infecting chancre, and the patient is consequently exposed to a course of mercury which is really unnecessary, cannot be determined, since there is nothing to detect the mistake. No secondary symptoms follow, and both patient and surgeon congratulate themselves on the success of the treatment.[2]

Besides the Hunterian chancre Mr. Lee describes two forms of infecting syphilis which are unassociated with ulceration, viz. (1) a pimple, the cuticle appearing as if peeled off the upper part of the glans penis, or a circumscribed patch remaining for days together, with a separation of epithelial scales mixed with lymph-globules from the surface, but with no specific induration; and (2) an indurated tubercle, formed below the skin or mucous membrane, without any visible loss of substance. The latter is regarded by many surgeons as a chancre which has skinned over. Infecting sores seem to be almost always single.

Treatment. When a sore has been diagnosed as infecting—i.e. as likely in the ordinary course to be followed by constitutional symptoms—the next question is as to the treatment. An immense preponderance of opinion at the present day supports the doctrine usually taught—and which I must say that I hold unreservedly—that the only efficient treatment for constitutional syphilis is mercury, and that that treatment is usually efficient. In thus teaching, the rational and judicious advocates of mercury do not intend to assert that syphilis is any exception to the common rules which are observed in all other diseases,

[1] Mr. Hutchinson teaches that 'the relationship of the soft to the hard sores is probably simply this—that the soft are due to the contagion of the pus produced by syphilitic inflammation, and the hard to that of the specific virus of syphilis,' referring to a clinical lecture on the relationship between soft and hard chancres in the 'Lancet,' for Sept. 1875. He therefore believes that, apart from any reinfection, the hard chancre may succeed on the soft one. The explanation must be allowed to be still theoretical, and seems to me highly dubious: but the practical point which Mr. Hutchinson enforces is unquestionable: viz., that even with sores which are obviously soft and non-infecting, 'until the incubation period is well passed (three to five weeks) the surgeon can entertain no confidence that induration will not occur, and he would act most unwisely to give his patient any opinion on the matter.' I presume Mr. Hutchinson means any absolute opinion, for there can be little doubt that in the great majority of soft sores no permanent affection of any kind ever ensues. The above statement occurs in the Commentary to Plate V. of Mr. Hutchinson's 'Illustrations of Clinical Surgery,' and I would refer the reader to the rules for the diagnosis of chancres there contained as embracing the experience of an eminent observer on this difficult subject: I have ventured to differ from him in his views as to the ordinary nature of phagedænic chancre.

[2] An interesting summary of the opinions of the most experienced surgeons of the day on the diagnosis of infecting and non-infecting chancres will be found in a paper by Mr. Venning, in the 5th vol. of the 'St. George's Hospital Reports,' entitled 'A Summary of the Evidence adduced before the Committee appointed to inquire into the Pathology and Treatment of the Venereal Disease, published in 1867.'

viz. (1) that diseases when left to themselves do not always run through all their phases, but that they may be spontaneously cured and disappear at any period of their course; so that constitutional syphilis, though it naturally tends to produce secondary symptoms, does not always do so, but may disappear spontaneously and no secondary or tertiary symptoms ever follow; and (2) that remedies, however efficient, are not always and uniformly successful; and, therefore, that mercury, though when thoroughly given it usually eradicates the disease, and especially if given as soon as the disease shows itself, yet does not always do so, and, therefore, that secondary symptoms are sometimes seen even after a perfectly satisfactory course of mercury. But many of the cases which are cited by the indiscriminate opponents of the use of mercury (who, I may perhaps be excused for saying, are not altogether very correct diagnosticians) in order to prove that constitutional syphilis can be treated with success by other means than mercury, so that no secondary symptoms will follow, were no doubt instances of mere local syphilis; and in many of the cases in which mercury is said to have failed to eradicate the disease so that secondary symptoms followed on its use, the course of mercury has been insufficient, or it has been begun after the secondary symptoms had really been developed.

Administration of mercury.

The best form in which to administer mercury has long been a subject of dispute. The common plan of giving it by the mouth has the advantage of requiring no confinement to the house, and being easily carried on without attracting observation—an important and in some cases almost indispensable condition in the treatment of these maladies; but it has the disadvantage of seriously disturbing the digestion and general health of many patients. The mildest form, and the one least likely to disturb the bowels and derange the digestion, is the blue pill, which may be given in doses of 8 or 5 grains twice a day, with a small quantity of powdered opium, this quantity of opium being the smallest which is found necessary to obviate irritation of the bowels—say gr. $\frac{1}{4}$ to $\frac{1}{2}$. This is to be continued for about six weeks, until all traces of the sore and all subcutaneous hardening around it and around the bubo have disappeared. During the course of mercury the state of the breath and gums should be cautiously watched. There is a peculiar fœtor in the mouth, easily recognised by the initiated, and usually accompanied by a coppery taste perceived by the patient, which generally precedes the spongy and congested state of the gums. When the latter sets in, and the blue line is seen round the roots of the teeth, it becomes a little unpleasant to the patient to chew a crust. If the mercury be pushed, in undiminished quantity, salivation commences, and then the gums recede from the teeth—the latter may drop out, and even the jawbones may become necrosed. At the same time a peculiar state of constitutional cachexia sets in, well known in old days under the name of 'mercurial erethism,' of which, happily, we see but little now, since the indiscriminate use (or rather abuse) of mercury has been given up. It is described by Pearson as being characterised by 'great depression of strength, a sense of anxiety about the *præcordia*, irregular action of the heart, frequent sighing, trembling, partial or universal, a small, quick, and sometimes an intermitting pulse, occasional vomiting, a pale, contracted countenance, a sense of coldness.' He adds that in this condition any sudden exertion will sometimes prove fatal, and that in his day almost every year one or two deaths took place in the Lock Hospital of men who had nearly, and sometimes entirely, completed their mercurial course, for which he could find no other explanation.[1]

Another mild and unirritating preparation of mercury, much in use when

[1] See South's 'Chelius,' vol. i. p. 677.

the drug is to be given for long periods, is the 'grey powder'—Hydr. c. creta —in 5-grain doses, either in the form of powder or pill. The late Mr. H. C. Johnson used to use the Ung. hydrarg. made into the form of a pill, as bringing the patient rapidly under the influence of mercury, and generally agreeing well with the bowels.[1] Calomel is more irritating, but also more powerful. It generally purges if given alone, but may be administered in 2 or 3-grain doses, with half a grain of opium, twice a day.

The endermic method of giving mercury is much more easily tolerated, produces far less depression, and is quite as efficient; but it is not so easily carried out, especially in private practice. In hospitals it is extensively used either by inunction or fumigation. The former consists in making the patient rub ʒss–ʒj of the Ung. hydrarg. into the inner surface of the thigh (where the skin is thin) until the ointment has entirely disappeared. In the latter the patient sits naked on a cane-bottomed chair, with a mackintosh sheet or a cloak or a common blanket wrapped round his neck and reaching to the ground all round the chair. Under the chair is placed a spirit-lamp, over which is a saucer containing a little boiling water, and projecting out of the saucer a shelf[2] on which is laid powdered calomel, gr. x-xx. As the water evaporates its vapour mixes with the sublimed calomel, and the fine powder is deposited on the moistened and relaxed skin, which is thus prepared to absorb it. The quantity of calomel, of water, and spirit is so adjusted in the regular lamp that when the flame goes out the saucer is dry and all the calomel sublimed. The patient should sit quiet for a few minutes, then put on his nightgown, and without wiping the skin at all get into bed. In hospitals, when the patient is confined to bed, the bath may be given at any time: in private practice it should always be at bedtime, since any check to the perspiration spoils the action of the remedy. It will usually be found that after about twelve baths, given every other day, the patient begins to get slightly affected. Then the action should be kept up by decreasing the quantity of calomel, so that the patient should just be conscious of the mercurial taste.

The action of mercury is made much more safe, speedy, and certain by confining the patient to bed, though, of course, this is seldom possible in ordinary cases of syphilis; and, as my late friend and teacher, Mr. Cutler, used to point out, it is a very useful precaution to weigh the patient every three or four days. A rapid loss of weight will often show that the remedy is disagreeing, and will spare the patient some more disagreeable proof of the fact.

When the patient cannot tolerate mercury the iodide of potassium may be administered, but it does not appear to exercise any radically curative influence on the syphilitic cachexia, though it rapidly removes some of its remoter effects. The other alleged remedies for syphilis are now generally thought to be quite inert.

There are surgeons who, while they admit the power which mercury exerts over the constitutional manifestations of syphilis in its secondary form, deny its power of preventing secondary symptoms, and therefore repudiate its use in primary syphilis. These are reduced either to an expectant treatment or to the extirpation of the sore by means of caustic. But there seems little proof of the advantage of such extirpation even when practised during the period of

[1] The formula for 'Sédillot's pill' is strong mercurial ointment, soap, powdered marshmallow, 1½ gr. of each.

[2] This little apparatus can now be had at any instrument-maker's. If a proper apparatus is not at hand an extempore contrivance may be made out of a common saucer with a piece of hot brick laid in the water, on which the calomel is to be strewn.

also to be met with in the later secondary and in the tertiary stages. The main forms of syphilitic sore-throat are three:[1] 1. The ulcer of the tonsils, a deep ulceration commencing on the surface of the central part of one or both tonsils, and accompanied by swelling and induration of the gland around it. This is said by Mr. Babington to be often accompanied by a tubercular eruption. 2. The phagedænic or sloughing sore-throat, commencing with ulceration on either the tonsils, the velum palati, or the pharynx, and often leading to extensive destruction of those parts. This is usually accompanied by rupia, and is therefore a later phenomenon. 3. The sore-throat which is due apparently to the development of psoriasis on the mucous membrane of the fauces or mouth. This is distinguished by the opaque white colour of the surface. 'This appearance sometimes supervenes at the edge of an ulcer on the tonsil. More frequently there is no ulceration, but simply this change of the surface, accompanied by more or less of redness, and as it were of excoriation of the neighbourhood, more or less swelling of the membrane, much soreness, but very little pain. This superficial affection may attack any part of the tonsils, arches of the palate, velum pendulum and uvula, and even the tongue or the inside of the cheeks. It is very frequently to be seen at the angles of the mouth. It often occupies the soft palate, spreading upwards in a semicircular form towards the roof of the mouth. The white appearance may be removed by slightly touching it with caustic, and then the surface beneath looks as if excoriated.' There are other forms also of syphilitic sore-throat, but the above are those which are commonly met with.

Affections of glands.

Next in importance to the affections of the skin and its appendages are those of the glands. It is an old and a very obvious observation in syphilis that the absorbent glands become less prone to share in the affections of the surface the later the stage of the disease is. Thus, in primary syphilis bubo is constant in the glands which derive their absorbents from the seat of the chancre; in secondary affections of the skin the absorbent glands are not nearly so often affected, and in tertiary disease they are hardly ever enlarged. But the glands themselves are very liable to secondary and tertiary syphilitic enlargement apart from all affection of the parts from which they derive their lymphatics. In those affections which are excited by the presence of eruption the gland is more disposed to inflammation than in those which are due to the effect of the general syphilitic poison. The posterior cervical glands, those lying in the posterior triangle of the neck, are the most commonly affected independently of other organs in constitutional syphilis, forming a chain of hard, knotty tumours under the edge of the trapezius muscle. The inguinal glands below Poupart's ligament are also often found thus affected. These glandular affections are more marked either at a later stage of the secondary or in the tertiary stage. The other common secondary affections are those of the periosteum, of the testicle, of the larynx, and of the eye, for which I must refer the reader to the chapters on diseases of those organs.

Inoculability of secondary syphilis.

That secondary syphilis is inoculable on a healthy person has been abundantly proved,[2] and practitioners of experience seem now to be of the opinion that syphilis is very often propagated in this manner. Mr. H. Lee has lately called particular attention to the controversy which has been going on ever since the days of Hunter on this subject. Hunter taught that the contagion of all venereal diseases—gonorrhœa, local syphilis, and constitutional syphilis—was the same, though he appears to have been perfectly acquainted with the

[1] See Hunter's works, vol. ii. p. 415, note by Mr. Babington.

[2] See 'Lancereaux,' vol. i. p. 69.

spreading at their edge, from which the old term 'serpigo' was derived. As the disease progresses vesicular and pustular eruptions are seen, the latter especially on the hairy scalp.[1]

Many other tissues of the body are, however, affected in secondary syphilis, though the deeper the parts affected are, the later probably is the stage of the disease, and the more it approaches to the tertiary period. Thus the eye and the larynx are affected in the later secondary stage—both parts of the general surface of the body, but lying deeper than the common integument, and liable also to be involved in the tertiary symptoms. The superficial affections also of the bones (periostitis, or nodes) are seen at the later periods of secondary as well as in the tertiary stage, but the deeper affections of the bones (caries and necrosis) are as a rule tertiary symptoms. The ulcerations of the skin which are due to syphilis may be the result of the giving way of skin affected by secondary eruptions, but are far more common after the suppurating eruptions (pemphigus, ecthyma, and rupia) which are characteristic of the tertiary stage. The affections of the viscera, such as the tubercles in the liver and the 'cirrhosis' of the lung which are due to syphilis, seem to be amongst its later manifestations, though in some cases they have been noted as secondary.

Mucous tubercle.

Other secondary symptoms must be briefly, but very briefly, mentioned. One of the most important is the development of 'mucous tubercles'—flat, raised, oval patches, generally situated at or near the junction of the skin and mucous membrane, covered with a whitish velvety epidermal tissue, and yielding a secretion which is easily inoculable, and which is probably a fertile source of syphilitic inoculation. Their usual seat is near the anus or vulva, and the mouth is a common situation, but any part of the body may be affected, especially where the skin is in folds, and where it is irritated by heat, dirt, and retained discharges. The local action of mercury is very beneficial in these cases. The tubercle generally disappears rapidly under the use of powdered calomel, kept upon it by means of some simple ointment, strict cleanliness being, of course, enforced. Syphilitic vegetations and condylomata are very nearly allied to mucous tubercle, and like it seem decidedly contagious. They

Alopecia.

will be best described in the chapter on SKIN DISEASES. One of the commonest of all secondary affections is syphilitic baldness, or 'alopecia.' The hair of the head becomes thin, comes away plentifully in combing, and at length the patient may become almost or entirely bald. There are cases much less common in which the baldness attacks other parts, usually the chin and eyebrows. The remedy lies in shaving the head, applying some gently stimulating lotion,[2] or in more serious cases painting the part occasionally with blistering fluid. But far more important than the local treatment is the correction of the syphilitic diathesis by a proper mercurial course. Alopecia, like many other of the symptoms which usually are secondary, appears also in the tertiary stage of the disease. Alopecia is often accompanied by desquamation of the epidermis—pityriasis, an affection which is essentially almost identical with the shedding of the hair. Onychia, again, is an affection very nearly allied to the affections of the skin and hair, and is often described as a psoriasis of the nails. I must refer the reader on this point also to the chapter on affections of the SKIN.

Sore-throat.

Syphilitic sore-throat is an almost universal symptom in the secondary stage, and generally the earliest of its phenomena. But affections of the throat are

[1] I would refer the reader for further details to the chapter on SKIN DISEASES.

[2] Mr. Nayler prescribes the following:—Liq. Ammon. Acet. ℥ ss, Sp. Ammon. Co. ℥ ss, Glycerine, ℥ ss, Aq. Rosæ ad ℥ viij.

also to be met with in the later secondary and in the tertiary stages. The main forms of syphilitic sore-throat are three:[1] 1. The ulcer of the tonsils, a deep ulceration commencing on the surface of the central part of one or both tonsils, and accompanied by swelling and induration of the gland around it. This is said by Mr. Babington to be often accompanied by a tubercular eruption. 2. The phagedænic or sloughing sore-throat, commencing with ulceration on either the tonsils, the velum palati, or the pharynx, and often leading to extensive destruction of those parts. This is usually accompanied by rupia, and is therefore a later phenomenon. 3. The sore-throat which is due apparently to the development of psoriasis on the mucous membrane of the fauces or mouth. This is distinguished by the opaque white colour of the surface. 'This appearance sometimes supervenes at the edge of an ulcer on the tonsil. More frequently there is no ulceration, but simply this change of the surface, accompanied by more or less of redness, and as it were of excoriation of the neighbourhood, more or less swelling of the membrane, much soreness, but very little pain. This superficial affection may attack any part of the tonsils, arches of the palate, velum pendulum and uvula, and even the tongue or the inside of the cheeks. It is very frequently to be seen at the angles of the mouth. It often occupies the soft palate, spreading upwards in a semicircular form towards the roof of the mouth. The white appearance may be removed by slightly touching it with caustic, and then the surface beneath looks as if excoriated.' There are other forms also of syphilitic sore-throat, but the above are those which are commonly met with.

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[1] See Hunter's works, vol. ii. p. 415, note by Mr. Babington.

[2] See 'Lancereaux,' vol. i. p. 69.

fact that some kinds of syphilis are local only; and he taught also that secondary syphilis was not inoculable on the patient's own body, while he doubted (though, as Mr. Lee shows, he did not deny, as he is usually represented as doing) that it can be inoculated on a healthy person. The experiment on which Hunter mainly relied for showing the identity of the gonorrhœal and syphilitic poisons was one which he made on himself by inoculating on his own person matter taken from a patient suffering, as he thought, only from gonorrhœa, and this inoculation produced primary and secondary syphilis. But Mr. Lee has called attention to the comparative frequency of discharges from the male urethra, in secondary syphilis, which proceed from some inflammation of the urethra the precise nature and seat of which has not yet been ascertained, but which seems to affect any part of the tube from the prostate forwards.[1] This affection is analogous to those somewhat rare cases in which the bronchial or the gastro-intestinal mucous membrane is affected in secondary syphilis, probably with some of the forms of eruption which are seen on the skin. The matter with which Hunter inoculated himself was, therefore, probably syphilitic.

Treatment. That secondary syphilis requires the mercurial treatment for its cure is admitted by many even of those who do not use mercury in the treatment of the primary disease. But the course of mercury must be more prolonged, and therefore milder, since the patient's general health is to be maintained during the whole period. The symptoms will, indeed, rapidly subside in many cases under the use of iodide of potassium, especially such as are accompanied by perceptible fibrinous exudation; it is, however, I think, generally admitted that such cures are usually only temporary, and that for the complete eradication of the diathesis a full and prolonged mercurial course is necessary. No hesitation need be experienced in prescribing mercury in cases where there is no ulceration or suppuration; but when this is the case mercury is generally held to be contra-indicated. I think, however, that anyone who will make trial of the fumigation of syphilitic ulcers or syphilitic eruptions of the pustular form, with very small doses of calomel (say 5 grains every night), will be convinced of the great benefit of this form of treatment. In many cases also of ulcerated sore-throat mercurial fumigation or a mercurial gargle (as Liq. hyd. perchlor., with equal parts of water) acts most favourably. In conditions of extreme cachexia, indeed, every form of mercury may be inadmissible; but in such conditions iodine is generally inadmissible also, and the patient's health must be renewed by careful feeding, stimulants in moderation, rest (if possible in bed), tonics, and opium, before any definite treatment is commenced. I know of no tonic which seems so generally beneficial as the compound decoction of sarsaparilla, a pint daily, with steel wine and laudanum if necessary. The administration of iodine and mercury together is a very successful plan of treating secondary syphilis. Thus the iodide of potassium may be given in doses of 5 to 10 grains, while the patient is undergoing a course of mild mercurial fumigation; or the red or green iodide of mercury may be prescribed either in pill or draught. The red or biniodide is the salt generally used, and may be given in doses of $\frac{1}{16}$ to $\frac{1}{8}$ of a grain in a pill three times a day, or in a draught by combining the iodide of potassium, gr. v–x, with the liq. hyd. perchlor., ʒss–j in some bitter infusion.

Tertiary syphilis. The tertiary stage of syphilis is distinguished from the secondary in the

[1] See Mr. Lee's Lettsomian Lectures, published in the 6th vol. of the 'St. George's Hospital Reports;' also his Lectures at the Royal College of Surgeons in 1875.

same way as the latter is from the primary, namely, by the occurrence of an interval of health. The secondary symptoms have disappeared, with or without treatment—for I repeat that secondary syphilis does sometimes disappear spontaneously—and then, after a very variable interval, commences the stage usually called tertiary, or, as Lancereaux puts it, the stage of the gummatous products. The period which separates the latest from the secondary stage of syphilis is very uncertain, and often it is not separated at all, the secondary or exudative stage passing on into the tertiary or gummatous condition with no definite limit; whilst at other times there is an interval of months or even years.

Gummata.

The main distinction between the secondary and tertiary stages of syphilis is that the new growths in the former resemble more the products of inflammation regarded as a reproductive process—they resemble more the fibrous tissue—while in the latter they resemble more the products of inflammation regarded as an ulcerative process. In fact, a gumma bears a very great resemblance to a granulation, and it is prone to soften, break down, and leave an ulcerating surface. Dr. Green thus describes the structure of gummata: 'The gummata consist of atrophied and degenerated elements embedded in a scanty

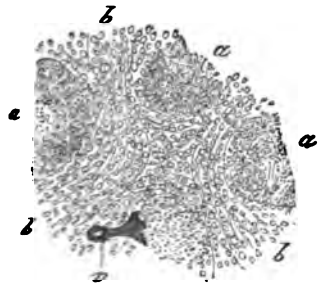


FIG. 179. Syphilitic gumma from the liver. *a*. Centre of the nodules in which the cells have become granular. *b*. Periphery of these nodules. *v*. Vessel. Enlarged 100 diameters. From Cornil and Ranvier.

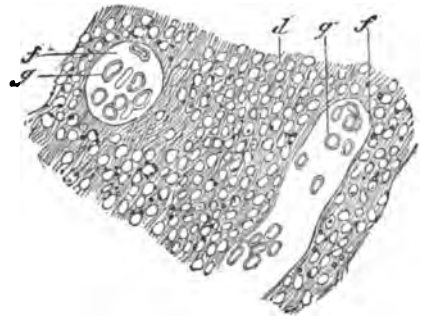


FIG. 180. The same preparation enlarged 400 diameters. *d*. Elements of the gumma. *f*. Cavity of the vessels in which the red globules *g* are seen.

and obscurely fibrillated stroma. The central portions of the growth are composed almost entirely of closely packed granular débris, fat-granules, and cholesterine, amongst which there may be an exceedingly scanty fibrillated tissue. Surrounding this, and directly continuous with it, is a more completely fibrillated structure; while the peripheral portions of the growth, which are continuous with the surrounding tissue, consist entirely of small round cells, resembling granulation-cells and lymph-corpuscles. The blood-vessels, which only exist in the external portions of the growth, are very few in number.'—'Pathology,' p. 120.

It is not, however, in every part that such gummatous tumours can be observed preceding the ulceration of tertiary syphilis; nor, again, do these gummata always ulcerate. In many cases the ulceration occurs without any recognisable deposit, being, however, probably preceded by a similar aplastic deposit diffused in the cellular tissue of the part. And in the interior of the body, as well as near the surface, tertiary syphilitic deposits may long remain inert, and then wither away into a kind of cicatrix or be reabsorbed.

The affections characteristic of tertiary syphilis appear in every part of the body, and I cannot affect to give a complete account of the matter here. I will endeavour to direct the reader's attention to the points most commonly

met with in practice. For the rarer and more dubious lesions which are connected with syphilis, such as the affections of the viscera and the nervous system, special works on the subject must be consulted.

The affections of the skin which are seen in tertiary syphilis are of the suppurative and ulcerative type—rupia and ecthyma are the commonest eruptions; and the softening of the subcutaneous gummata frequently leads to ulceration. The various forms of syphilitic ulcer are described in the following chapter. Even more important than the external affections are the diseases of the bones which so constantly occur in tertiary syphilis, and which now no longer affect only the periosteum and external table of the bone in the form of nodes which show little tendency to suppuration; but, on the contrary, the tissue over the bone rapidly softens and exposes a carious or necrosed condition of the bone itself, which is regarded as being the result of a similar aplastic deposit in the substance of the bone to that which we have just spoken of as met with in the cellular tissue of soft parts. These syphilitic affections of bone will be afterwards more fully treated of in speaking of the DISEASES OF THE BONES. The glands are deeply affected in tertiary syphilis, not exclusively or even mainly the absorbent glands (though the induration of the posterior cervical and inguinal glands is constant in tertiary syphilis), but also the great secreting and blood glands—the liver, spleen, thyroid, testicle, &c.—and it seems probable that though generally the syphilitic deposit occurs in the form of definite masses (gummata or syphilitic tubercles), yet that the diffused waxy or lardaceous disease of these organs may also be sometimes of syphilitic origin. The nervous system is also profoundly affected, not merely by inflammation propagated to the brain, spinal marrow, and nerves from their bony cavities, but by tertiary deposit in the structure of the nervous masses or their membranes, leading to irritation or paralysis.

Thus it seems that there is no part of the body which may not be and is not constantly affected in constitutional syphilis.

Summary of the principal lesions met with in constitutional syphilis.

The lesions met with in constitutional syphilis have recently been thus described by one of the greatest living authorities on the subject, Lancereaux.[1]

On the skin, nodules or projecting tubercles, grouped and circumscribed, leaving indelible cicatrices; in the cellular tissue similar tubercles, often more voluminous, which sometimes are absorbed, at others eliminated by ulceration of the skin over them; in the voluntary muscles, nodules of the same kind, which are usually absorbed, leaving a cicatrix in the muscle; in the articulations grey or yellowish deposits, usually in the subsynovial tissue, sometimes in the substance of the ligaments, such deposits being localised generally in the great joints—the knees or elbows—usually in one or two only and most frequently in symmetrical articulations; in the bones, the syphilitic lesions are also as a rule circumscribed, producing limited periostitis or limited periosteal deposit, the new bone differing from the normal bone chiefly in the manner of its connection with the shaft, and in the greater size of its medullary cavities. In later stages of syphilis the bone perishes extensively, in consequence, as it seems, of an invasion of its tissue by gummatous material, which either obstructs its nutrition entirely, giving rise to necrosis, or breaks down in larger or smaller tracts, and so leads to syphilitic ulceration or caries. In the lymphatic glands, the syphilitic deposit is usually rather organisable than ulcerative; so that they are enlarged in volume by syphilis. In the arteries the syphilitic deposits are also prone to be circumscribed; so that,

[1] This account is somewhat modified from the *résumé* of a lecture by Lancereaux in the 'Gaz. des Hôp.' for October 25, 1877.

though in some cases they affect the whole circumference of the vessel, or obliterate it, more commonly they are limited, giving rise to lateral softening and aneurism. Such deposits are noted also in the lymphoid tissue which forms the sheaths of arteries in certain situations, and syphilitic lesions are very common in the cerebral vessels, easily distinguished by their limitation from the general degeneration of ordinary atheroma (endarteritis). In the viscera, the lesions of syphilis display the same general characters; those of the liver and testicle being extremely like each other; the organs being sometimes traversed by fibrous bands, more or less retracted, often radiating from a common centre, sometimes sprinkled with masses of deposit, the central part of which softens into a gumma, while the circumferential organises and forms a cicatrix. The same phenomena are observed also in the lungs, kidneys, and brain.

Treatment of tertiary syphilis.

The treatment of the tertiary must be the same in principle as that of the secondary stage of syphilis. But here again, as the cachexia is more profound, so must the treatment be milder, more supporting and stimulating, and longer continued. The iodine or mercury which may be necessary for the treatment must be introduced gradually in very small doses combined with tonics and opium. Wine and good food are essential. Change of air, a warm climate, and the use of appropriate mineral waters are most useful adjuncts to a treatment which must be carried on through so long a period of time.

The length of time during which a course of mercury should be continued is stated by Ricord [1] at about twelve months, and Lancereaux estimates it at about half a year. In such prolonged courses the mildest preparations of mercury must be selected, the dose must be a very moderate one, intermissions must be allowed from time to time, and the preparation and vehicle must be varied.

Infantile or congenital syphilis.

Two special forms of syphilis remain to be described—infantile or congenital syphilis and vaccino-syphilis. Congenital syphilis is a form of secondary or constitutional disease, transmitted to the fœtus in utero either through the blood of the mother or the semen of the father, or both. The old idea that infants are inoculated with syphilis at the time of birth from syphilitic sores in the mother's vulva is given up. Such an occurrence may be possible, but the disease which we usually see is strictly analogous to secondary syphilis, and is, in fact, a form of it, differing only in this, that the primary sore has occurred on the body of the parent instead of the infant itself. The popular name of infantile syphilis is 'the snuffles,' and this expresses one of its chief features—a persistent coryza, or snuffling in the nose, along with which is a reddish or coppery eruption, usually either roseola or lichen, on various parts of the body, and especially on the genitals and on the palms and soles. In these latter situations, however, it is sometimes more of a scaly nature; there are also very commonly crescentic patches of mucous tubercle on the interior of the mouth, on the lips, anus, &c., and the lips are usually surrounded with cracks. Combined with these symptoms there is a peculiar cachexia, a wasted look like that of age, and a good deal of emaciation, with a yellow complexion.

These symptoms begin at a variable period. If they commence in utero they usually lead to the death of the fœtus, and often to abortion. But very commonly they do not commence till some weeks after birth; and it is

[1] See Carter 'On the Principles of Ophthalmic Therapeutics,' St. George's Hospital Reports,' vol. vii. p. 111.

believed that the affection in the parent becomes milder as the stage of the disease is later, so that the later children are less profoundly poisoned than the earlier. Thus there are families in which, after several abortions, a child has been born alive, but with advanced congenital syphilis, and soon died; the next has perhaps survived, and the later children have shown no marks of the disease for the first few months of life, or even perhaps at all.

The diagnosis of this complaint is a matter of much importance. My late friend Dr. Ballard published a paper which he read at the Medical Society of London, the effect of which would have been almost to shake our belief in the reality of congenital syphilis altogether. This conclusion I cannot accept, but I think Dr. Ballard succeeded in showing (what, indeed, I have always believed) that many of the cases which are diagnosed as syphilis infantum are really only eruptions due to dirt and neglect. Children's skins are tender and irritable, and if they are wrapped up in hot dirty flannel in which putrefying urine and fæces are allowed to remain, they will be affected with some of those eruptions which are included by nurses under the vague name of 'red-gum'—however healthy and sound may be their constitution—and such neglected children are also very likely to suffer from chronic cold; but in the genuine instances of infantile syphilis the eruption is quite different from the effects of common irritation, and it is present on the soles of the feet and palms of the hands, and in the mouth and cheeks, where no such cause is possible. Besides, the family history is a very powerful aid to the diagnosis, and in doubtful cases there is no objection to defer the specific treatment until the effects of cleanliness and attention have been ascertained.

When, however, the diagnosis is clear the mercurial treatment is urgently indicated. Infantile syphilis has its tertiary stage, though the phenomena are not very well understood. I have seen two or three cases in which the bones, especially of the palate, have been destroyed, and there seems no doubt that some of the gummatous tumours found in the lungs, liver, spleen, and other viscera in childhood have been syphilitic.

Lately the subject of the syphilitic affections of the bones in infancy has been more carefully examined, and it appears that such affections are not so rare as was at one time believed. The whole subject has been worked out with great care by Dr. R. W. Taylor of New York, whose work 'On Syphilitic Lesions of the Osseous System in Infants and Young Children' contains a full account of the labours of previous observers. He there shows that infants affected with congenital syphilis frequently suffer very early in life from the formation of nodes at the line of union between the shaft and epiphysis, which are usually chronic and then are perfectly amenable to treatment; but sometimes occur in an acute form, and dissolve the connexion between the epiphysis and the rest of the bone, so as to destroy the joint. He also points out the diagnostic symptoms by which such swellings may be distinguished from those of rickets, which are (briefly) the earlier appearance of the syphilitic lesions, the absence of the prodromata of rickets, the presence of other syphilitic symptoms, the rarity with which the ribs are involved, the history of the case, and the effects of treatment. There is not much fear of confounding this syphilitic disease with the 'Acute Arthritis of Infants' spoken of by Mr. T. Smith in vol. x. of the 'St. Bartholomew's Hospital Reports.' No doubt similar lesions may follow on the acquired syphilis of childhood. These articular or periarticular affections are not unusually combined with nodes on other parts of the skeleton. They are amenable to a gentle and prolonged mercurial treatment.

The affection of the cornea described by Mr. J. Hutchinson as interstitial keratitis is admitted to be syphilitic, and so is the condition of the permanent teeth which he has also described. The syphilitic keratitis will be found treated of in the chapter on DISEASES OF THE EYE, but a few words must be added here about the condition of the teeth. It is only seen in the permanent teeth, at least it is only in them that it can be recognised, since the milk-teeth are subject to so many irregularities that if any of these are due to syphilitic causes it has not been found possible to identify them. The affections of the teeth are believed by Mr. Hutchinson to be the effects of stomatitis merely; [1] so that if a syphilitic infant escape stomatitis his teeth will not be irregular, and, therefore, the non-occurrence of this dental irregularity is no proof of the absence of syphilis, though its presence is a strong confirmation of the diagnosis. The syphilitic characters are only marked in the incisors and canines, which will be found to be small, of a bad colour (dirty grey instead of pearly white), and notched, so as to display a deep groove on their edge, or sometimes several (serrated teeth), or two with a central projection (peg-top teeth). They are also soft, from deficiency of enamel, and therefore wear down easily, so that these characters can hardly be recognised after many years of wear. It is, therefore, only from the age of eight to twenty-five or thirty that any confident opinion can be formed on the subject.[2]

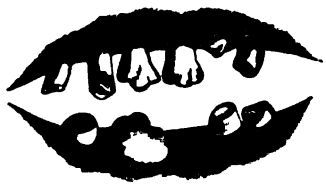


FIG. 181. Syphilitic teeth.—From a paper by Mr. Jonathan Hutchinson, 'Path. Soc. Trans.' vol. x. p. 296.

The occurrence, then, of tertiary symptoms after infantile syphilis forms a powerful argument for eradicating the disease by mercury, and the effect of the disease on the general health is a still stronger one. When mercury is administered in an appropriate case the general health, the complexion, and the digestion immediately improve, while under ordinary remedies (chlorate of potash, &c.) the child may have been previously deteriorating from day to day. I have frequently tested this experimentally.

There is no necessity for giving large doses of mercury—in fact, they are

[1] 'Path. Trans.' vol. ix. p. 449.

[2] There can be no doubt that since the publication of Mr. Hutchinson's observations on syphilitic teeth much error has prevailed on the subject, and many irregularities of the teeth which have no connexion whatever with syphilis have been vaguely spoken of as 'Hutchinson's teeth,' and set down as proof of congenital syphilis. And I may say that many experienced surgeons and dentists (even though they allow that the condition of the teeth described by Mr. Hutchinson is often found in children who have been syphilitic) doubt whether it is decisive of the fact that the child or its parents have been syphilitic. (See an interesting discussion at the Association of Dental Surgeons, reported in the 'Med. Times and Gazette,' May 13, 1876.) The reader who will turn to Mr. Hutchinson's 'Illustrations of Clinical Surgery,' Pls. XL., XLII., XLIII., will see his latest views on the subject. These may be put shortly as follows. There are various deformities of the teeth due to other kinds of stomatitis (classed as mercurial, and due, as is believed, to the abuse of mercury) which require to be distinguished from the syphilitic deformity. The main diagnostic signs are that the mercurial form chiefly affects the first molars (which are the test-teeth for mercurial stomatitis, the bicuspids being often healthy), and causes pitting of the enamel over a great part of the surface of the teeth affected; while the syphilitic disease chiefly affects the central incisors (which are the test-teeth for syphilitic stomatitis), and causes a linear notch in the centre of the edge of the tooth penetrating both enamel and dentine, and is very often associated with lamellar cataract. It must be allowed, however, that the subject is not as yet completely worked out—nor could it be expected that in so short a time a matter depending on such difficult and dubious data could have been settled.

not well borne by the bowels—nor, indeed, is there any need to administer mercury by the mouth at all. If the mother or nurse be also syphilitic, the calomel vapour-bath can be administered to both at once with advantage: otherwise the old plan recommended by Brodie answers admirably, viz. to make the child wear round its arm a piece of flannel, about two inches wide, smeared with Ung. hydr. The objection to this plan is that ignorant people think 'nothing is being done' for the child, and consequently are very liable to neglect the use of the ointment. In such cases 1½ or 2 grs. of grey powder, with 8 grs. of compound chalk-powder, may be given twice a day. The treatment should last about six weeks, or about a fortnight after all traces of eruption, snuffles, and cachexia have vanished. No other treatment is needed, except cleanliness, and, if the obstruction of the nose is so extreme as to constitute an impediment to sucking, constant cleansing of the nostrils by gently syringing with an alkaline lotion.

Under this treatment the disease is seldom dangerous, nor, indeed, is congenital syphilis, as far as I have seen, often fatal directly; but many syphilitic infants die, in consequence of the cachexia, being too weak to resist any intercurrent disorder.

We ought not to quit the subject of congenital syphilis without noting the important observation of Mr. Hutchinson, which seems to be supported by other experience, that healthy women may be infected with secondary syphilis by carrying syphilitic children. In such cases there is, no doubt, some difficulty in determining whether the woman has been infected directly from her husband or indirectly from her child. The test is, of course, the occurrence or non-occurrence of primary syphilis; but this may easily have been overlooked.

Non-congenital syphilis in infants.

There is no doubt that syphilis is inoculable in the secondary as well as in the primary stage—in fact, one of the forms of secondary syphilis (the mucous tubercle) yields a secretion which is often very contagious—but other secondary sores may be communicated, though their contagion is less active than that of the primary sore, so that it requires a longer contact in order to act, and takes a longer time to develop its effects. But it must be recollected that the effect of the inoculation of syphilis anywhere, whether primary or secondary, is to produce a chancre on the part inoculated.

This appears to be the usual cause of the non-congenital form of syphilis in infants. In countries where wet-nursing is common it appears to be not very unusual for an infant when nursed by a syphilitic woman to contract the disease, either from secondary ulcers on the nurse's nipples, or from contact between some accidental abrasion on any part of its body and some sore on the person of the nurse. In the former case the chancre will be on the lip, and the bubo which also accompanies it will be in the glands under the jaw; in the latter case the glands next in sequence to the inoculated crack will be affected.

Vaccino-syphilis.

This accidental syphilis of infants is exactly the same disease essentially as vaccino-syphilis, in which the syphilitic poison is inoculated by mistake in conjunction with the vaccine matter. Such cases are rare, but it is impossible to deny that they do occur, although it would appear that a very moderate amount of caution would prevent them.[1]

[1] The cautions requisite are well known. They are four in number, viz.: 1. Use a perfectly clean lancet. 2. Take the lymph not later than the eighth day after vaccination, so as to avoid any mixture of pus. 3. Take only lymph—no blood or any other secretion. 4. Examine carefully the child from whom the lymph is taken, so as to be sure that it is not

In vaccino-syphilis the vesicle soon suppurates, and the edges of the resulting sore become hard and chancrous,[1] the axillary glands soon enlarge and run the ordinary course of the indolent non-suppurating bubo; the hair then begins to drop off, and eruptions show themselves on various parts; in fact, the usual train of secondary and tertiary symptoms ensue.

Other irregular forms of syphilis.

The treatment of these unusual instances of syphilis is exactly the same as that of the common disease; but their exceptional character renders the diagnosis somewhat difficult, as it is also in the irregular chancres that occur in adults. Such chancres are most common either on the lip or on the finger. A chancre on the lip does not present exactly the same appearance as it does in the genitals. It is generally much larger and flatter, and there is less induration around it; but its indolent appearance, flat surface, and accompanying bubo in the glands beneath the jaw will generally indicate its nature to a practised eye; and if there be much doubt, a few weeks' delay will usually prove the existence of syphilis by the appearance of a secondary eruption. Chancres on the fingers are still harder to diagnose. In fact, the natural action is interfered with in these exposed parts by the constant irritation to which the sores are subjected. But in doubtful cases the effect of mercury generally settles the question, by producing the rapid subsidence of the sore and disappearance of the bubo. I have seen many instances of this in supposed epithelioma of the lip.

Syphilitic inoculation and syphilisation.

It remains to say a very few words about syphilitic inoculation. The purposed inoculation of syphilitic matter into the body of a healthy person is an experiment which I cannot speak of as otherwise than unjustifiable, even if the subject be the experimenter himself, though we have the example of Hunter; and if done on another person, however well instructed that person may be on the subject, it seems to me little less than criminal. But to inoculate innocent and ignorant patients in a hospital, as has been done before now, is an action which should at once be made the subject of judicial punishment.[2] So far, I presume (at any rate in the last particular), most people would agree. Yet syphilitic inoculations have been most extensively practised of late years in hospitals, on patients who could only very imperfectly apprehend the enormous risk which they were running for the purpose of testing a theory which teaches that, as the constitution may be made proof against a renewed attack of smallpox or scarlatina or any similar constitutional malady by saturating the body with the virus, so a person might procure an immunity from constitutional syphilis if his or her system were once properly 'syphilised,' or saturated with the disease.[3] The analogy no doubt is good, if constitutional

syphilitic. It seems probable that the blood or any other secretion of a syphilitic person may convey the disease, and Mr. Lee believes that the mixture of blood with the syphilitic virus under any circumstances much increases the virulence of its contagion. Hence the desirability of taking lymph only; but there can be no doubt that most of the instances of vaccino-syphilis were produced by a neglect of the ordinary precautions—1 and 4 above.

[1] 'The conveyance of syphilis by vaccination is never effected without the intervention of the vaccination-chancre.'—Hutchinson's 'Illustrations of Clinical Surgery,' p. 113. Here the reader will find portraits of the vaccination-chancre contrasted with other unhealthy conditions of the vaccine vesicle, together with many details for which I cannot find space.

[2] Can anyone read without indignation and disgust the record of experiments such as those of Waller of Prague, quoted by Mr. Lee, in 'St. George's Hospital Reports,' vol. vi. p. 6, where healthy children, who were chosen for their proved immunity from syphilitic cachexia, were inoculated with the secretions of diseased prostitutes? No scientific end can for a moment justify the use of means so barbarous and so criminal.

[3] 'Med.-Chir. Trans.' vol. l. p. 281.

syphilis be inoculable on the patient already affected (for not even the most ardent advocate of the method has proposed to give a healthy person syphilis in order to protect him from it); and that this was so was taught unhesitatingly by Ricord, who laid it down as a test of the infecting or constitutional disease that the matter from the chancre would reproduce a similar chancre, if inoculated on a different part of the patient's own body; from the second chancre a third could be produced, and so on until after a variable number of successive crops of chancres had been produced (sometimes as many as fifty or more) the system would get charged with the virus and no further action could be elicited. And this was the treatment which was absolutely followed out for a long time in some Continental hospitals, and which received a full trial at our own female Lock Hospital in London. Mr. H. Lee, however, teaches the very reverse of Ricord's doctrine. He says that the chancres which are autoinoculable are the soft chancres, that the matter from a Hunterian chancre is only inoculable in its initial stage, before the characteristic induration has manifested itself, or at a later stage, whenever the sore has been artificially irritated and made to suppurate; and that even then the inoculation will not last any time, but that on the second or third trial it will fail; while, on the other hand, the soft sore can be inoculated for an unlimited number of times; and this doctrine seems to be *à priori* the more probable, and is now extensively accepted. If this be so, syphilisation [1] would be doubly unjustifiable, since at the end of the process the patient would only have procured immunity from a local action which was never formidable, and would have ceased much earlier if left alone, and an immunity which is only temporary, as Mr. Lee demonstrated clearly by re-inoculating a patient who had previously been thoroughly syphilised not very long before, and was thought to have obtained complete protection from all future infection.

As a method of treatment, therefore, syphilisation is now given up, at least in this country; but it is still practised as a means of diagnosis. If a sore be repeatedly inoculable it may safely be pronounced syphilitic. Secondary sores can be inoculated a few times, but not nearly so often as suppurating primary chancres. Those who hold unreservedly to Mr. Lee's doctrine would believe that the repeated inoculability of a sore was a contra-indication to the use of mercury.

A very interesting question is, what degree of immunity does a patient obtain by a previous attack of constitutional syphilis against a renewed infection? To this question we are not in a position at present to give an altogether confident answer. That there is considerable immunity from the risk of another constitutional infection cannot be doubted, but several cases, recorded by careful observers, seem to show that this immunity is by no means so complete as in the case of the eruptive fevers, though in them it is not perfect.[2]

[1] By syphilisation is meant the process of inoculating the patient from the original sore (say on the genitals) in three or four places on a different part of the body, usually the thigh, from these on another part, and so on, until sometimes the whole body is covered with the marks of more than 100 chancres. (See the cases recorded in the 50th volume of the 'Med.-Chir. Trans.')

[2] See a series of cases of re-infection reported by the late Mr. G. Gascoyen, in the 58th volume of the 'Med.-Chir. Trans.'

CHAPTER XXI.

ULCERS. CICATRICES, AND THEIR DISEASES.

THE process of ulceration has been described in a previous chapter (see p. 14). When this process has gone on for some time around a wound, so that it has spread to a large size, or when, as is more commonly the case, a slough has formed and come away, the granulating surface which is left is called an *ulcer*, and it maintains this name till the healing process has been completed and the whole is filled up and converted into a *scar*.

The matter which is furnished during the ulcerating process varies in character according to the nature of the ulcer, being sanious or foul, ichorous, contagious,[1] &c., approaching more and more nearly to healthy pus as the healing process advances. The distinctive characters of ulcers depend on differences observed in the base, the granulations and the pus which they secrete, the edge, and the parts surrounding the ulcer.

Ulcers are divided into classes (I.), according to the constitutional causes on which they depend, and (II.) according to the local characters which they present.

I. With reference to the constitutional causes which modify the character of the ulcer, the following varieties are described :—

Healthy ulcer.

1. The *simple* or *healthy* ulcer, such as that which follows accidental injury in a healthy person. Its base is level and slightly depressed. The granulations are florid, uniform, small, soft, elastic to the touch, vascular but not usually bleeding spontaneously, and not highly sensitive ; the edges shelve gently, are not peculiarly hard, and are of an opaque white at the circumference, where the epithelium is condensed and heaped up, getting redder towards the ulcer ; the pus is healthy or 'laudable.'

This form of ulcer will heal under the simplest treatment, or, in fact, under no treatment at all, if defended from all irritation or congestion. If the patient is obliged to go about, the ulcer should be protected from congestion by strapping and bandage. This is most thoroughly done by the plan called Baynton's. The limb is encircled with strips of strapping, each lying half over the one below it, and all crossing in front, from an inch below to as much above the ulcer, and is evenly bandaged from the foot to some distance above the sore.

The use of Martin's india-rubber bandage as a substitute for the old plan of strapping has now become very common; and it has the advantage of being a much more simple application, and one that the patient, if an intelligent person, can apply for himself. But in order to succeed it must be very

[1] The specific characters of pus have not been much studied, but we sometimes see the inoculability of matter tested in the case of ulcers or sores presumed to be syphilitic and in cases of gonorrhœal ophthalmia. Syphilitic pus will excite a specific action, reproducing a similar action for a great number of times in cases of soft sore, and something similar takes place in hard sores which have been inflamed. The inoculation of ordinary pus, on the contrary, only causes a little pimple, which soon disappears. So with gonorrhœal matter. Pus taken from a case of acute gonorrhœa and placed in the conjunctival sinus will excite the most acute inflammation, often rapidly destroying the eye, while pus from an ordinary abscess will only cause a slight and transient inflammation, and often none at all.

carefully and evenly applied, and the most scrupulous cleanliness must be enforced. For want of these precautions I have often seen this bandage do harm.

Inflammatory ulcer.

2. The nearest to healthy ulcers are the inflammatory. They are usually single and small; the skin around is hot and red, often œdematous, with burning pain in the part. The base is level and little depressed, but ragged and flocculent; the granulations are generally absent, so that the base looks raw; it is ruddy in colour, or ash-grey, or yellowish, with thin adherent sloughs. The edges are abrupt, irregular, or shreddy. The pus is ichorous, thin, watery, excoriating the edges, and frequently bloodstained.

In the treatment of such ulcers the main point is to subdue the inflammation by rest in the raised position of the limb, with warm soothing applications, such as warm Goulard-water Oss., tinct. opii ʒj., on a thick, soft rag or compress of lint covered with oiled silk. In some cases benefit seems to accrue from applying leeches at a distance.

The patient is often weak, and requires tonics and support.

Eczematous ulcer.

3. The *eczematous* resemble the inflammatory ulcers, but are complicated with eczema of the surrounding skin. The constitutional condition which is the remote cause of the eczema must be discovered and treated—whether it be gout, struma, or other cachexia—and the eczematous skin must be treated as well as the ulcer. Wet strapping to the limb is often useful, i.e. the application of strips of wet linen exactly in the same way as the strips of diachylon or other plaister would be used for strapping it, the application being kept moist by wetting it as often as necessary; or blotting-paper may be applied, or the skin dusted with starch or washed over with nitrate of silver lotion. Nayler recommends an ointment of red precipitate of mercury, 5 to 10 grains to the ounce, covered with a compress of linen wrung out of hot water.[1]

Occasional harm from healing an ulcer.

Paget[2] says: 'It is probably these more than any other ulcers that have given rise to the question whether ulcers should always be cured if possible. There is sufficient reason to believe that the cessation or cure of an established eczema has been attended with serious disease of the brain or other internal organ; the same may happen with an ulcer of this or probably some other kinds. The event is certainly very rare, but it may often be right to guard against it by making an issue in some place more convenient than the ulcer, or by renewing the cutaneous disease by counter-irritants.'

Ulcers similar to the eczematous are met with in other constitutional eruptions.

Cold ulcers.

4. *Cold* ulcers resemble small inflammatory ulcers, occurring spontaneously, especially at the ends of the fingers and toes, preceded by severe pain, and small inflammatory spots. They occur in persons of feeble circulation, whose feet and hands are always cold, and the parts around them are livid and cold to the thermometer.

The treatment is by dry applications or stimulating lotions, tonics, especially iron, with purgatives, warm clothing, warm bathing, and exercise.

Senile ulcers.

5. *Senile* ulcers somewhat resemble the inflammatory, but with more tendency to sloughing. The base of the ulcer is generally dry, the granulations rusty in colour and surrounded with a dusky pinkish area. The skin is sometimes sloughing in one part while the ulcer is healing in another. Such ulcers are found in the dry, withered limbs of those 'who are growing old with either a timely or premature degeneracy.'

For their treatment, besides generous diet, wine, tonics, opium, warmth,

[1] See the chapter on Eczema in Nayler's 'Diseases of the Skin,' 2nd ed.

[2] 'Syst. of Surg.' vol. i. p. 184, 2nd ed.

and all the comforts which old age should have, stimulating and balsamic applications are required. Paget recommends strapping them with equal parts of Ung. Resinæ and Balsam of Peru spread on lint.

Strumous ulcers.

6. *Strumous* ulcers are such as occur in strumous subjects, usually in combination with other local symptoms. They often follow on suppurating glands or softening of subcutaneous masses of tubercle, as evidenced by the presence of small nodular masses, which soften, with a low inflammation of the skin over them. They are often multiple, the individual ulcers being originally small and oval, but afterwards coalescing into irregular shapes. They are found more frequently in the situation of the lymphatic glands, i.e. in the neck and groin, and are frequently on the face and head; but they do also occur on the limbs. The base is soft, unequal in level, the granulations are large, pale, soft, œdematous, often exuberant, and bleed easily; the pus is thin, greenish-yellow, and possibly curdy; the edges are undermined, pale pink or purplish, with overhanging, thin, or irregularly hardened skin, and there is often a warty growth of the papillæ around (particularly in the hands and feet), which, combined with the other characters of the edges, gives some resemblance to epithelioma, but strumous ulcers want the hard base, sinuous raised border, and rapid progress of cancerous ulcers. There is seldom much pain, though where they have existed long the parts around become œdematous.

The edges often require to be destroyed with caustic potash before the sore will heal.

The general treatment of struma must be pursued, and the ulcers locally stimulated with iodine in the form of ointment, or of lotion applied on linen strapping, or with nitrate of silver lotion. Their scars are often causes of deformity, either by contraction or by overgrowth, which is more frequent, and which must be combated by repeated slight blistering.

Very deep, obstinate, and extensive ulcers may justify amputation, particularly when situated near the ankle, and when any neighbouring joint or bone is simultaneously affected. I am anxious, however, to call the reader's attention to the great benefit which often results in these and in most other of the less healthy forms of ulcer from the free removal of the ulcerating surface with some raspatory, such as Volkmann's spoon, followed by the unsparing application of the actual cautery. When the cauterised parts have come away a more healthy surface is left exposed, and will often begin to granulate healthily; so that by appropriate treatment, skin-grafting, &c., it may be brought to heal. I have thus treated almost all forms of unhealthy ulcers, syphilitic, callous, lupous, and even one which was judged both on naked eye and microscopical examination to be epitheliomatous, with the happiest results. In some of the cases the fasciæ, the tendons, the periosteum, and even the bones were freely exposed, and in one remarkable case the man was admitted on his own request in order to have the leg amputated.

Scorbutic ulcers.

7. *Scorbutic* ulcers are those which accompany scurvy, and derive their peculiarities from the effusion on their surface of the same semi-organised plastic material which occasions the swelling of the gums, the intermuscular swellings, and the vibices and petechiæ of scurvy.

The ulcers are livid, with irregular, swollen borders, their surface covered with a dark, spongy, fœtid crust, which adheres so strongly that its removal causes free bleeding, and which is rapidly reproduced. The treatment must be directed to the constitutional disorder. When this is removed the ulcer becomes of a simple nature.

8. Gouty persons often suffer from inflammatory or eczematous ulcers, but

Gouty ulcers.

the proper *gouty ulcer* is that which is found over gouty deposits or in parts distinctly gouty, and it usually involves only part of the thickness of the skin. The base is florid, the granulations absent, or greyish or yellow, the edges low and shelving, the pus thin and ichorous, frequently leaving a white, chalky deposit. The ulcers are very indolent, 'exceedingly slow in getting either better or worse.'

The treatment here again is directed to the disorder of the constitution. The local treatment is limited to water-dressing, simple cerate, or weak solutions of nitrate of silver.

Syphilitic ulcers.

9. *Syphilitic* ulcers are those which form on the skin in secondary or tertiary syphilis. They are situated usually on remote parts, but the genital organs may also be affected with secondary sores, and it seems certain that the matter from such sores is contagious.

Secondary ulcers are much more rare than tertiary. They generally proceed from the sloughing of parts affected with pustular eruptions in cachectic persons.

Tertiary syphilitic ulcers 'usually appear among the latest signs of syphilis, and are most severe in those who are most reduced, whether by the syphilitic poison abiding in them or by mercury, or by both, or by poverty, intemperance, or naturally unsound constitution. There is probably no form of ulcer in which the influence of all these evils is more intensely felt.'

Tertiary ulcers are divided into two forms, not, however, generally distinguishable at a late stage: (*a*) the *superficial*, which follows on rupia or some other ulcerative eruption, sometimes, though not usually, commingled with such eruption. These are best known by the annular or horseshoe form spreading from the exterior, while healing from the inside (serpigo), and are often multiple, arranged in some circular or curved figure. Their local characters are not otherwise very decisive, and the diagnosis is made from the history or concomitant symptoms. Sometimes the discharge is heaped up into scabs resembling those of rupia. These ulcers have usually no induration, and often do not penetrate the whole cutis.

(*b*) The *deep* tertiary ulcer usually commences in the softening of a subcutaneous gummatous swelling, over which the skin gives way, leaving a circular sore, which looks as if the skin had been punched out. The base of the sore is often found sloughing. The sore is at first surrounded by a ring of induration, which is gradually destroyed and falls into the ulcer. There is often an area of dusky redness round the ulcer which forms a contrast to the pink halo already described as surrounding the strumous ulcer. Tertiary ulcers may extend to any depth, through the fascia to the muscles, periosteum or bone. They occur in late stages of syphilis, often with no other syphilitic symptoms, though in other cases ostitis or periostitis may be present elsewhere. Frequently the diagnosis can only be made by the effects of specific treatment. In ulcers situated on the leg it is useful to remember that the simple and the varicose ulcers generally occur on the inner aspect of the limb, a little above the malleolus, and are usually single; while the syphilitic ulcers occur more often on the outer side, and are commonly multiple, very often appearing simultaneously on both legs, and sometimes are nearly or quite symmetrical on both.

Specific treatment is usually of no use so long as the ulcer is inflamed; but when by rest and soothing applications all inflammatory complications have been subdued it generally succeeds rapidly. The iodide of potassium, in full doses of gr. v.–viij. or x. three times a day, usually procures the speedy healing

large burn), we have only recently obtained any means of artificially hastening their cicatrisation. This is now most happily effected, at least in many cases, by the method of skin-grafting, invented by M. Reverdin of Geneva, and introduced into this country by Mr. Pollock.[1] For the success of this process it is essential that the granulations should be perfectly healthy, and that all irritation in the sore should have ceased—i.e. that the ulcer should be prepared to cicatrise—and it is at any rate desirable that the patient's general health should be good. Then, if a small piece of the surface of the skin, consisting of little more than its epithelial layer, be laid on the granulations and left undisturbed for a few days, it will often form a nucleus from which cicatrisation will extend rapidly in all directions, as it sometimes does from the islands of skin which may be left undestroyed in the centre of an ulcer. The pieces grow best when planted not far from the edge of the sore (say about half an inch), so that the sore can first be diminished by a zone of skin-grafts planted all round its margin, and then the operation be repeated, and so on, until it is all covered. The growth of the graft seems to depend on the cells of the rete Malpighii. Attempts have been made to produce the same effect by grafting merely the cells scraped from the surface or loosened by a blister, but such cells are as a rule effete and will not grow.[2] Nor is there any proof that the tissue of the cutis itself, and still less the subcutaneous cellular tissue, take any part in the new formation. The red bud-like appearance which the graft presents for the first few days after its insertion is doubtless due, as Dr. Page points out, to the desquamation of the effete superficial layers of the transplanted epidermis, and to the transparency of the cells of the rete mucosum, allowing the colour of the subjacent parts to show through them.

It is best, I think, to take up a small portion of the true skin as well as the epidermis, in order to make sure of removing the rete mucosum, but on no account should the whole thickness of the skin be cut through. An ingenious combination of fine forceps with scissors enables the surgeon to remove a small piece with hardly any pain at all; but when this is not at hand a pair of fine forceps and sharp curved scissors answer the purpose.[3] The grafts should be very small, hardly larger than a pin's head. They should be laid firmly on the granulations, about an inch apart; and if the patient can be trusted not to disturb them in any way, I think they are best left exposed for a few hours. After this, or at once, if there is any danger of their being disturbed, they should be covered with oiled silk, moistened with oil to prevent it sticking when removed, and the whole fixed with

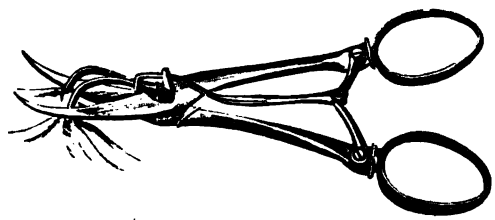


FIG. 182. Skin-grafting scissors. The piece of skin which is shown in the grasp of the forceps is larger than would be taken in practice.

[1] M. Reverdin's original patient was presented to the Soc. de Chirurgie de Paris on Dec. 8, 1869 ('Bull. de la Soc. de Chir.' Nov. 27, 1871). Mr. Pollock's first case was published in the year 1870.

[2] See an interesting paper on this subject by Dr. Page of Edinburgh, 'Brit. Med. Journ.' March 27, 1871.

[3] The pieces are generally taken from some other part of the patient's own body; but the process of cutting them is so little painful that often a bystander offers his arm for the purpose. They should be taken from a part where the skin is quite healthy, thin, and fine.

cells of epithelioma, and they are not attended with glandular disease or with deposit in remote parts.

Their edges are usually smooth, hard and rounded, sometimes slightly tubercular. The base is tough and hard, smooth, yellowish-red, half-dry and glossy; but when any granulations are present they are sometimes exuberant. In rare cases there is a warty, lobed mass like epithelioma, and such cases can only be distinguished from epithelial cancers by the microscope. The ulcer is indistinguishable by the naked eye from epitheliomatous ulceration. Mr. Butlin [1] thus describes the microscopical appearances of rodent cancer: 'Masses or groups of cells, in alveoli formed by fibrous tissue, . . . the cells smaller than those of the surface epithelium, and resembling rather in size and form the cells of the root-sheaths of the hairs. They are so closely packed that no intercellular substance can be seen between them. . . . Scattered among the central cells, cell-nests or epidermic globes can often be distinguished.' Thus the resemblance to epithelioma is very marked, and, as Mr. Butlin observes, there seems little doubt that rodent is a kind of carcinoma. Its origin has been conjectured to be from the sweat-glands or from the hair-follicles. The difficulty of classifying it depends more on its strict localisation than on its anatomical structure; for it remains a local disease during the whole of a long life, and is never found to affect the glands or to be reproduced in remote parts of the body.

The most perfect general health is quite compatible with the most extensive destruction of the tissues by rodent ulcer. In the case referred to in the footnote on the preceding page the patient lived for years in good health with almost the whole face destroyed, and then died of old age. Further, it has been abundantly proved that if the parts concerned in the rodent ulcer be entirely removed, so that nothing but healthy parts are left, the patient may live for an unlimited period without the return of the disease. In other cases, however, it has returned, probably on account of incomplete removal.

The indication, therefore, is to remove the disease thoroughly and completely, and this is best done by a combination of the knife and caustics. All the visible ulcer having been cut out freely, the part should be left for a day or two till the bleeding has quite ceased, and then an active caustic, such as the chloride of zinc, spread on lint, is to be freely applied to the exposed soft parts. If the bones are implicated they must be soaked in strong sulphuric acid until they come away. I well remember seeing at the Middlesex Hospital a case which had been thus treated with success, in which a great part of the side of the face and one eye had been removed, and the neighbouring part of the base of the skull, so that in looking into the gap the pulsation of the brain was perceptible over a large surface. The hiatus in the face had been cleverly filled up by a mask of vulcanite painted to resemble the natural features.

Cancerous ulcers.

12. *Cancerous* ulcers occur either from the adherence of the skin to a cancerous mass or from the deposit and softening of cancer in the skin itself. Those which commence in the skin are generally of the epithelial variety.

The edges of cancerous ulcers are raised and everted, hard, nodular, and warty. Their granulations are coarse, uneven, deepest in the centre of the sore, and they bleed spontaneously; the base is hard, nodular, and surrounded by the cancerous deposit; the pus is foul and ichorous. There are often enlarged glands or other cancerous deposits in the neighbourhood.

It is sometimes of importance, and especially in tumours of the breast, to

[1] 'Syst. of Surg.' 3rd ed. vol. i. p. 154.

distinguish the ulceration produced by a cancerous tumour from that which may be caused by any other formation.

The main sign is that cancerous tumours cause ulceration by infiltrating the skin with cancer, which then breaks down, while innocent tumours cause ulceration by pressure only. Therefore in the latter case, besides the absence of all other signs of cancer, it will be noticed that the skin is merely thinned, and retains its perfect softness and flexibility even up to the edge of the opening.

The treatment of cancerous ulcers consists in removing the whole part on which they are situated, whenever that is possible. In parts which do not admit of amputation the skin around the ulcers may be freely cut away, and in some instances a healthy cicatrix will be obtained, and the disease at any rate temporarily checked. If this also is impossible, only palliative treatment can be adopted in most cases—i.e. some application which will keep the wound clean, and a sufficiency of opium or other narcotic to allay the pain—though there is no objection, if the disease has not gone too far, to the removal of the ulcerated surface with some powerful caustic, of which the sulphuric acid made into a paste with asbestos seems the least painful. This treatment, indeed, can only be regarded as palliative, for the disease is almost sure to return soon, even if the caustic should succeed in removing it for a time.

II. The following varieties of ulcer depend on local conditions :—

13. *Varicose* ulcers are such as are occasioned by the pressure of the blood in varicose veins above, rendering the skin congested and prone to low inflammation. These ulcers are of the ordinary chronic, inflammatory, or eczematous kind, and are situated usually above the inner ankle. Well-regulated pressure, and the maintenance of the elevated position of the limb, are necessary adjuncts to the ordinary treatment above described; or the veins may be obliterated by operation (see the chapter on DISEASES OF VEINS). Tonic medicines are indicated, and opium is useful where there is pain or inflammation. Varicose ulcers.

14. *Œdematous* or *weak* ulcers are such as occur on œdematous limbs, and the granulations of which are œdematous from partaking of the general œdema, or from being constricted by a neighbouring scar or by tense skin. The remedies are to reduce the œdema, to apply astringents to the granulations, to strap and bandage the ulcer and the whole limb below it; or, in some cases, to divide the constricting medium. Œdematous or weak ulcers.

15. *Exuberant* ulcers are those in which the granulations project considerably beyond the surface, but are free from any cancerous deposit. In such cases the general health must first be carefully attended to, free purgation being usually necessary. The granulations are to be repressed by pressure and by the light application of stick-caustic. Exuberant ulcers.

16. *Hæmorrhagic* ulcers are such as bleed from a great variety of causes; bursting of varicose veins and venous congestion are the common causes. Phagedænic and cancerous ulcers often bleed spontaneously. Vicarious menstruation and ulceration into a bloodvessel are other, but much rarer, causes of bleeding. Hæmorrhagic ulcers.

The appropriate treatment is involved in the discovery of the cause.

17. In *neuralgic* ulcers the pain generally depends on some unhealthy condition of the ulcer or on some local cause—true neuralgia attacking an ulcer is much rarer. The remedy is to cure the ulcer, for which purpose its division is often indicated. The painful ulcer of the anus is an example; but painful ulcers of the legs are also often brought to heal by complete division, under Neuralgic ulcers.

anæsthesia, the knife being carried through their whole extent in various directions.

Inflamed ulcers.

18. *Inflamed* ulcers are distinguished from the 'inflammatory' described above, in that the inflammation in these depends on a local irritation, while in those it is part of a constitutional condition.

In inflamed ulcers there is an increase of pain with redness and œdema around them—the discharge is copious and bloody; the granulations become swollen and congested, and then slough; the edges are often abrupt or jagged. Such inflammation occurring in a callous ulcer is often curative, as in the treatment by blistering, or the inflammation excited by erysipelas.

The indications of treatment in a inflamed ulcer are to remove any source of irritation, to apply soothing warm lotions, and to enforce rest.

Callous or indolent ulcers.

19. The *callous*, *chronic*, or *indolent* ulcer is usually situated on the leg, with its long axis parallel to that of the limb. Sometimes it encircles the leg. Its base is deep, flat, pale, or tawny, and adherent to the deeper parts; the granulations are very small; the edges raised and callous, with heaped-up white epidermis; the pus is thin and often offensive. The kinds of ulcer thus modified are usually the syphilitic, inflammatory, and eczematous; but any kind of ulcer may become chronic, and when a specific ulcer does so the specific treatment ceases to be efficient.

The most effective plan of treatment is by blistering—a common blister applied over the whole sore and its edges often sets up an inflammatory action, which leads to cicatrisation, and removes the heaped-up epidermis, which seems to interfere with the healing of the edges. It is not very painful, and the epidermal tissues, or their scar-like islands, which the blister may remove from the surface of the ulcer, are of no real value in closing the sore. Slighter cases may be brought to heal by strapping and bandage, with some exercise of the limb; and opium internally seems often of service. In the more advanced cases incisions may be made through the ulcer and through its base well into healthy parts on all sides. And there are callous ulcers which cannot be brought to heal, and in which amputation may be justifiable. But the healing of all obstinate forms of ulcer has lately been rendered much more feasible by the introduction of the method of skin-grafting—a method which is often used to expedite the process in healing a large ulcer or to supply material in one which (like the surface of a burn) is so large that no healthy scar can be formed on it.

20. Phagedænic ulcers have been already treated of (page 56).

Cicatrices and their diseases.

The healing of an ulcer produces a scar or cicatrix. The process has been described above (p. 15); and when the scar-tissue remains permanent, although the scar is ugly and of a lower organisation than the natural parts, yet it causes no important inconvenience. But the imperfect vascularity of scars, their low and abnormal growth, and the absence from them of the sebaceous and sweat glands which lubricate the natural skin, render them peculiarly liable to various diseases and degenerations, which it will be convenient to describe briefly in this place.

Ulceration of scars.

The most common surgical complication of a large scar is its breaking down and ulcerating, a very common event in deep and extensive scars.[1] Such ulcers are slow to heal, and are very prone to recur, so that often when the scar is seated on a limb, amputation becomes necessary.

[1] 'Of all scars,' says Sir J. Paget, 'none are so ready to ulcerate as those that adhere to bones; and the ulceration may happen twenty or more years after their formation.'

The scars of large burns are peculiarly liable to this degeneration, which is best combated by attempting to implant fresh tissue in the sore by means of skin-grafting. Grafting, however, will not, in all probability, prove successful until some healthy action has been set up in the part, which may be effected by some active stimulant, as iodine, brushed over the part, in increasingly strong solution, or perhaps pure, or blistering fluid; though before making trial of such powerful irritants it is well to try the gentler stimulus of mercurial lotions or some of the balsams. As prophylactic measures against this tendency to ulceration everything which tends to promote rapid union of the wound may be reckoned, and all possible means should be used to protect large scars from cold and from any accidental friction or violence.

Neuralgia of scars.

Another common and very distressing affection of scars is neuralgia, or constantly recurring pain. This proceeds sometimes from unknown or constitutional causes, in which case it must be treated like any other neuralgia; in others from local peculiarity, as from adhesion of a scar to a subjacent bone or from implication of the enlarged ends of nerves in the cicatrix, and such conditions may in some cases be relieved by subcutaneous separation of the scar from the underlying tissues, or by removal of the affected nerve or nerves. Mr. Adams[1] has called especial attention to the possibility of remedying the deformity caused by depressed cicatrices in exposed parts, like the neck or cheek, by freely dividing the subcutaneous attachments of the scar, raising it well from the parts below, and passing needles at right angles to each other under the raised and everted scar, so as to keep it in this position for about three days, after which time the needles may be withdrawn.

Excessive formation of scar.

A defect which is very frequent in slowly-forming scars (and especially those that follow strumous ulcers) is their excessive formation. Their superficial part is heaped up, cord-like, and very hard, and they adhere in an unnatural manner to the deeper tissues.[2] This, like every other defect of scars, is best obviated by getting the wound to heal rapidly, if that be possible. Otherwise it becomes very difficult to correct it, the only available means being to reduce it by constant blistering or painting with iodine.

Keloid scars.

Closely allied to this is the limited excess of growth by which one or more and often very numerous flat, rounded tumours are formed on the cicatrix. When such keloid growth is solitary it is difficult to see any difference between it and an excess of scar-formation. But when a number of small scattered tumours occur upon a large scar the distinction becomes apparent. The structure of these tumours is identical with that of the scar, viz. a lowly-organised fibrous tissue, only mingled in keloid with 'cell structures in progress of development, or arrested and degenerate in their incomplete forms,' to an extent which is not seen in merely thick scars. The admixture in these keloid growths of cells in process of development corresponds to the tendency of such growths to increase, and to the irritation which they sometimes cause, and their property of returning after removal, which is sometimes very troublesome. The same remedies as for excessive growth may be tried, but are usually of little avail; and the excision of the growth is often followed by its return of a larger size, so that it is very doubtful policy to operate, except in cases where

[1] 'Brit. Med. Journ.' April 29, 1876.

[2] Sir J. Paget points out that even after the deepest wounds which can never heal by first intention—such as that of lithotomy—though the scar at first implicates all the tissues for a great depth, yet that ultimately only a thin cicatrix should be left, which, when examined, will be found to be perfectly superficial, and to move as the skin moves over the deep fascia.

the whole part can be removed, and healthy surfaces brought together for immediate union. This can usually be done in the growth which follows occasionally in the lobule of the ear after piercing for earrings, though no such operation should be recommended unless the growth is really of a size to cause considerable deformity, and is on the increase. The keloid of scars differs from the 'true keloid' of Addison in certain particulars which will be pointed out in the chapter on diseases of the SKIN.

Other tumours of scars.

Other forms of tumour are occasionally met with in scars, but the epithelial cancers are the only tumours of much practical importance. They were first minutely and accurately described by Mr. Cæsar Hawkins as 'warty tumours of cicatrices.'[1] The great majority of such tumours are epithelial cancers, and all ought to be regarded and treated as being of this nature, though in some rarer cases it seems that their course is that of an innocent tumour; in fact, a mere collection of large warts growing on the surface of the scar. Such tumours form most commonly on scars of slow formation, as those of burns, and especially on those which used to follow the complicated superficial injuries inflicted in a military flogging. As in other cases of epithelioma, the complete removal of the part affected holds out a tolerably good prospect of permanent recovery, or at least of a considerable period of immunity from return. The glands, as Mr. Hawkins points out, are rarely affected in this form of tumour.

Contracted cicatrix.

The most troublesome of all the consequences of scarring is the contraction which slowly-forming deep cicatrices are so liable to undergo—a contraction so powerful that it will bind the arms to the trunk, distort the most powerful joints, and even alter the shape of the bones. The worst cases of this deformity occur in the neck, by which the chin is drawn down and fixed upon the chest, all the features of the face are distorted, the shape of the jaw so changed that its body is more vertical than horizontal, and the patient's appearance rendered in the highest degree repulsive.

The best plan in these as in all other progressive disorders is to endeavour to hinder their commencement, or, when this is impossible, to treat them before they become inveterate. In all deep burns, and in all other injuries which destroy the whole skin to any great extent, the greatest care ought to be taken to keep the parts on the stretch during the whole period of union, whenever that is possible. If a scar which has fully formed shows a tendency to contract, that tendency is to be counteracted either by gentle and constant manual extension, the scar being well oiled, and gently but very frequently stretched (which seems to me the best plan when the services of an intelligent nurse or mother can be secured), or by the action of a constant extending force, as a rack-and-pinion apparatus, or a weight. But when contraction is inveterate and very firm, or when mechanical extension is impracticable, some of the autoplastic operations described in the section on PLASTIC SURGERY may become necessary, for which I must refer the reader to that place.

Skin-grafting.

What has been said about scars and their diseases illustrates in every topic of which I have treated the absolute necessity of rapid union. This is one of the many reasons which induce English surgeons utterly to repudiate the foreign practice of stuffing wounds with charpie, and, on the contrary, to seek to remove every obstacle to their immediate union. But in cases where large granulating surfaces must be kept exposed for an indefinite period (as after a

[1] 'Med.-Chir. Trans.' vol. xix. 'Contributions to Pathology and Surgery,' vol. i. pp. 149–169.

large burn), we have only recently obtained any means of artificially hastening their cicatrisation. This is now most happily effected, at least in many cases, by the method of skin-grafting, invented by M. Reverdin of Geneva, and introduced into this country by Mr. Pollock.[1] For the success of this process it is essential that the granulations should be perfectly healthy, and that all irritation in the sore should have ceased—i.e. that the ulcer should be prepared to cicatrise—and it is at any rate desirable that the patient's general health should be good. Then, if a small piece of the surface of the skin, consisting of little more than its epithelial layer, be laid on the granulations and left undisturbed for a few days, it will often form a nucleus from which cicatrisation will extend rapidly in all directions, as it sometimes does from the islands of skin which may be left undestroyed in the centre of an ulcer. The pieces grow best when planted not far from the edge of the sore (say about half an inch), so that the sore can first be diminished by a zone of skin-grafts planted all round its margin, and then the operation be repeated, and so on, until it is all covered. The growth of the graft seems to depend on the cells of the rete Malpighii. Attempts have been made to produce the same effect by grafting merely the cells scraped from the surface or loosened by a blister, but such cells are as a rule effete and will not grow.[2] Nor is there any proof that the tissue of the cutis itself, and still less the subcutaneous cellular tissue, take any part in the new formation. The red bud-like appearance which the graft presents for the first few days after its insertion is doubtless due, as Dr. Page points out, to the desquamation of the effete superficial layers of the transplanted epidermis, and to the transparency of the cells of the rete mucosum, allowing the colour of the subjacent parts to show through them.

It is best, I think, to take up a small portion of the true skin as well as the epidermis, in order to make sure of removing the rete mucosum, but on no account should the whole thickness of the skin be cut through. An ingenious combination of fine forceps with scissors enables the surgeon to remove a small piece with hardly any pain at all; but when this is not at hand a pair of fine forceps and sharp curved scissors answer the purpose.[3] The grafts should be very small, hardly larger than a pin's head. They should be laid firmly on the granulations, about an inch apart; and if the patient can be trusted not to disturb them in any way. I think they are best left exposed for a few hours. After this, or at once, if there is any danger of their being disturbed, they should be covered with oiled silk, moistened with oil to prevent it sticking when removed, and the whole fixed with

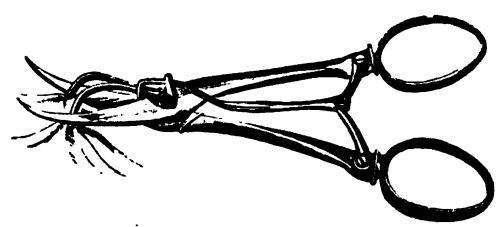


Fig. 182. Skin-grafting scissors. The piece of skin which is shown in the grasp of the forceps is larger than would be taken in practice.

[1] M. Reverdin's original patient was presented to the Soc. de Chirurgie de Paris on Dec. 8, 1869 ('Bull. de la Soc. de Chir.' Nov. 27, 1871). Mr. Pollock's first case was published in the year 1870.

[2] See an interesting paper on this subject by Dr. Page of Edinburgh, 'Brit. Med. Journ.' March 27, 1871.

[3] The pieces are generally taken from some other part of the patient's own body; but the process of cutting them is so little painful that often a bystander offers his arm for the purpose. They should be taken from a part where the skin is quite healthy, thin, and fine.

strapping and covered with cotton-wool. They should then be left undisturbed for three or four days and re-dressed as before. At first they change into little round, vascular-looking buds, which sometimes become almost imperceptible at first in the neighbouring granulations, but afterwards the new cuticle is seen extending in all directions from the bud. That this new cuticle is formed by growth from the old is proved by the fact that when black skin is engrafted on an ulcer in a white man, as recorded by Mr. Bryant, or when the reverse experiment is made, as in a case in my own practice, the newly-formed skin is of the colour of the graft to the extent due to the action of the latter. My own experience, as far as it has gone, leads me to believe that the cicatrix formed by skin-grafting is more highly organised and less liable to all forms of degeneration than that which is produced by the slower natural process.

CHAPTER XXII.

DISEASES OF THE BONES.

Ostitis.

INFLAMMATION in bone is strictly analogous to the same process in soft parts; in fact, it occurs in the soft parts of the bone. Its first effect is to increase the size of the vascular channels of the bone, which also become more irregular in shape and outline; the union which previously existed between the earthy salts and the vascular network in which they are contained is loosened and the salts partially removed, while their place is occupied by inflammatory products (leucocytes, serous effusion, pus-globules, newly-formed fibrous tissue), and thus the compact tissue is converted into a kind of cancellous tissue, while the cells of the cancellous tissue are much enlarged and the bone becomes soft, light, fragile, and much moister than in its natural state.[1]

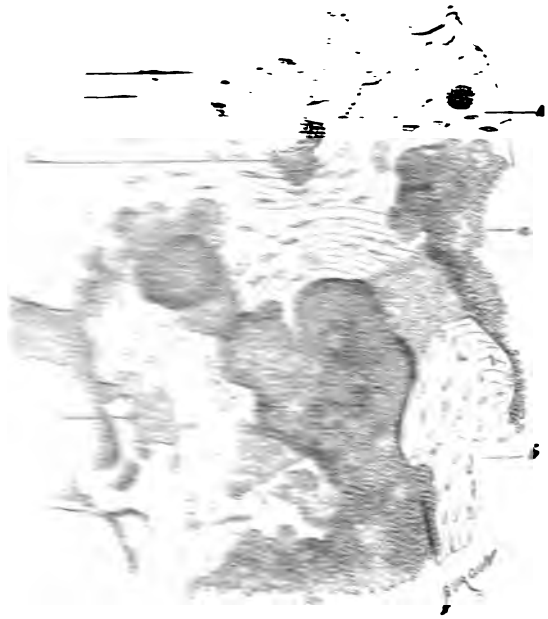
In the microscopic examination of the interior of a bone in an early stage of acute inflammation the cells of the lacunæ are found to be enlarged and proliferating, while the bony tissue itself is irregularly eroded, forming worm-eaten spaces of various shapes sometimes called 'Howship's lacunæ.' (Fig. 183.) Similar erosions are seen on the walls of the Haversian canals and on the periosteal surface, accompanied by proliferation of the cells of the deep layer of the periosteum, which have so great an analogy to the bone-cells. The spaces so formed are occupied by various cell-forms, or in the better marked specimens by distinct granulations, which differ from the granulations of soft parts not so much in structure as in function, since their cells are capable, as are the cells from which they are derived, of generating bone. Looked at more minutely some interesting points may be verified. (Fig. 184.) In the first place the erosion of the medullary spaces is seen to be evidently produced by the action of the medulla, i.e. by the enlargement of the old vessels and growth of new ones, and by the multiplication and enlargement of the cells both of the bone and of the medulla; and these enlarged bone-cells are seen to bear a striking resemblance to, in fact to be tolerably identical with, those giant-cells which are found in the marrow of fœtal bones, and in myeloid tumours, and which have been called 'osteoclasts' by Kölliker, from the function which he ascribes to them of dissolving or absorbing the pre-existing bone, as the new bone is being formed.[2] Whatever may be thought of this physiological speculation, the presence of similar cells in bone which is undergoing inflammatory erosion has an interesting bearing upon it. In other sections taken from parts where the bone is in contact with cartilage (Fig. 185), its line of junction is seen to be suffering similar erosion from cells of the same nature sinking into and sucking out, as it were, the tissue both of the bone and cartilage, the latter of which structures shows the usual traces of inflammation in the neighbourhood.

[1] For more detailed accounts of the early phenomena of inflammation in bone I must refer the reader to Von Bibra, 'On the Decomposition of the Bone by Caries,' in Liebig ü Wohler's 'Annalen,' vol. lvii.; Barwell, in 'Brit. and For. Med.-Chir. Rev.' April 1860; Black, 'On the Pathology of Tuberculous Bone,' Edin. 1859; and my own essay, in the 'Syst. of Surg.' 3rd ed. vol. ii.

[2] See Gray's 'Anatomy,' 10th ed. p. lxii.

more or less of pus will be

of common inflamma-



lamellæ *b* are irregularly
cellary cells, as shown at *c*
Magnified 100 diameters.



FIG. 185. A section from the same case as fig. 184 to show the appearances at the line of junction of the bone and cartilage. *a a a*. Bone trabeculæ with the bone-corpuscles and giant-cells or 'osteoclasts.' The latter are seen eating away not only the bone-substance but also the superjacent cartilage at the line of junction. *b*. The articular cartilage becoming calcified. At *b'* are shown the cartilage-cells with the matrix beginning to calcify around them, and staining deep blue with hæmatoxyline. *c*. An artery cut transversely. From a preparation by Mr. Stirling.

tion of bone. As this subsides, and as the inflammation passes from the rarefying, ulcerative, or destructive, to the condensing, ossifying, or reproductive stage, the cells are replaced by fibrous tissue in which bone is deposited, and

thus the condition known as sclerosis is reached. But in most cases the chronic inflammation is not preceded by any suppuration. The exact phenomena of chronic inflammation in its initial stage are not so well known, from the difficulty of meeting with it in that condition, but it may be fairly inferred that they differ in no essential respect from those above described, i.e. that the early stage consists in absorption of the earthy material caused by the proliferation of the cellular elements of the organic framework of the bone.

To this early softening stage of ostitis succeed other stages, equally analogous with the results of inflammation in soft parts, but modified by the peculiar condition of the parts. Thus the inflammatory products may pass through the stage of fibrous organisation into that of ossification, and so new bone be produced, just as it is in the union of fractures. In fact, the ordinary process of repair of fractures is that of 'first intention' in union of wounds of bone, while the repair of compound fractures exhibits the process of union by granulation. Just so after common inflammation. The leucocytes which have been effused into the intervascular spaces of the bone itself, into the cells of the cancellous tissue, medullary canal, or still more frequently the interval between the periosteum and the surface of the bone, become developed first into fibrous tissue, and next (in some cases, as it seems, almost simultaneously) the earthy constituents of the bone are deposited in this tissue, in a manner similar to that of the intermembranous ossification.

Chronic inflammation of bone is generally the result of one of three causes—syphilis, rheumatism, or injury, arranging them in what is probably the order of their frequency. It is usually accompanied by a considerable increase in the density of the bony tissue, so that the thickness of the compact wall is much increased, and in some cases the whole bone is converted into compact tissue—no medullary canal being perceptible—and the density of this inflammatory compact tissue may be much greater than that of normal bone—more resembling ivory. The length of the bone may also be much increased, as in simple hypertrophy. In fact, it is by no means easy to say in diseases of bones where simple hypertrophy ends and chronic inflammation begins. Sir J. Paget has recently described ('Med.-Chir. Trans.' vol. lx.) a singular disease, of which he cites five cases, three from his own practice, under the name of ostitis deformans. In this disease the long bones are chiefly affected—becoming hard, heavy, elongated and variously deformed—the skull was also implicated in more than one instance, and the spine was in two cases curved and shortened. It is curious that in three of the cases, cancer attacked some part of the skeleton. In Sir J. Paget's first case, the skull was evidently enlarged from chronic inflammation. In one of the other cases (under Dr. Wilks's care) the appearances in the skull were more those of osteoporosis, and the case is referred to under the head of hypertrophy in Wilks and Moxon's 'Path. Anat.' 2nd ed. p. 10. This singular and rare disease appears to have no causal connexion with any known diathesis, such as rheumatism, struma, or syphilis; nor has the treatment adopted had any influence on its progress. It does not appear to be usually painful, and the general health has been perfect. Dr. Wilks's patient died from fixation of the chest through disease of the ribs, three of the others from cancer; the fifth was living when last heard of. Since Sir J. Paget's paper appeared, examples of the disease have been seen at most of the great hospitals.

Ostitis deformans.

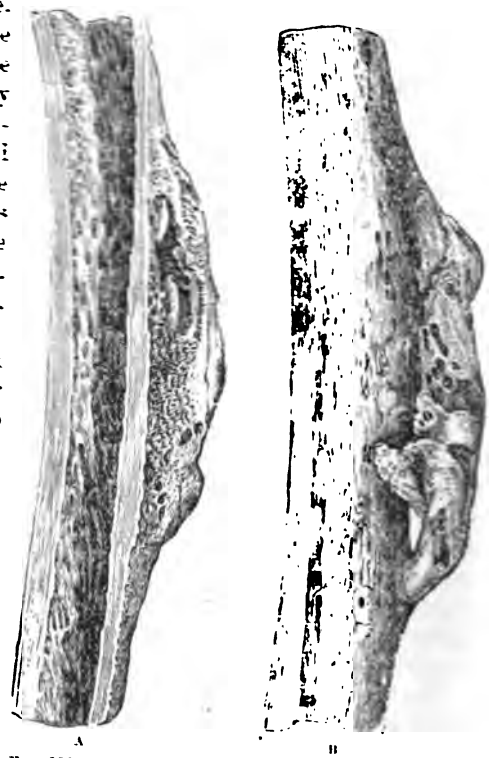
We know how slight a stimulus will produce ossification on the deep surface of the periosteum, which, in fact, is the source of the greater part of the growth of the bone; so that, as M. Ollier has shown, the periosteum in

Periostitis.

[illegible] when transplanted into other parts of the body or into the [illegible] other animals, will produce bone from its deeper surface. This form of inflammation is called Periostitis. It is almost always associated with more or less inflammation of the substance of the bone itself, and [illegible] only to be regarded as one of the forms of ostitis; yet as it is [illegible] as a separate disease, it may be better for practical [illegible] to regard it. Periostitis occurs in two very distinct manners, [illegible] chronic, and the acute or diffuse periostitis.

[illegible] is a very common affection; it occurs very often as a conse- [illegible] and when limited to a small extent of surface constitutes [illegible] called Node, from the lump or 'knot' (nodus) which it produces [illegible] surface of the bone. [illegible] are most common on the [illegible] bones, as the [illegible]. They [illegible] and in- [illegible] raised up and [illegible] surface of the [illegible] tumors [illegible] surface of the [illegible] inflamed. [illegible] are syphilis, [illegible] scrofula.

[illegible] are pain in [illegible]—as all other [illegible] are apt to do [illegible] it begins to get [illegible], swelling and ap- [illegible] softening of the affected [illegible] really due to fluid [illegible]. The swelling is [illegible] and small, like a [illegible].



A B

FIG. 186. A internal and B external view of a preparation illustrating the ordinary anatomy of periostitis, from a well-marked example of that disease, in the Museum of St. George's Hospital.—'System of Surgery,' 3rd ed. vol. ii. p. 281.

If left alone such nodes pursue one of three courses—many are absorbed, i.e. the fluid is absorbed as the inflammation subsides and the swelling disappears, or the inflammatory effusion ossifies, and a periosteal thickening of the bone remains permanently; or, finally, suppuration follows, and an ulcerating carious surface is exposed. Syphilitic nodes occur either in the secondary or tertiary stage, and, as may be inferred from what has been said on pp. 391–2, those which are secondary are more prone to resolution or ossification, while the tertiary nodes, like other gummata, are more prone to suppuration and caries.

The treatment of nodes consists in the proper remedies for the general constitutional state, combined with counter-irritation. Iodide of potassium in moderately large doses, combined with opium, certainly seems to relieve the pain both of syphilitic and rheumatic nodes. Five grains of the iodide three times a day may be combined with 10 or 20 drops of laudanum, according to the severity of the pain, and the dose may be raised to 10 or 15 grains of the

salt if it is judged necessary. There are cases where the formation of a node, especially if the inflammation is severe and suppuration is threatening, is accompanied with so great pain that the division of the periosteum by an incision reaching from one side of the swelling to the other is called for, and this measure often gives instant and permanent relief. The ordinary cases of 'chronic periostitis,' so called, are really cases of inflammation of the whole bone, in which there is more or less deposit on its surface, which may be perceptible to the hand during life, but in which there is also induration and thickening (*'sclerosis'*) of the whole bone. The symptoms are wearing pain, heaviness of the limb, probably some increase of the temperature, little if any redness, and irregular deposit on the surface of the bone.

The only treatment which is available is the same as recommended for nodes; but it seems uncertain whether such treatment has really much specific effect on the disease, though rest and shelter and good medical supervision no doubt do much for its cure.

Diffuse periostitis. Acute periosteal abscess.

Diffuse or suppurative periostitis, leading to the condition known as acute periosteal abscess, is one of the gravest affections of bone, frequently producing a general pyæmic condition, and indeed sometimes itself only a manifestation of general pyæmia. Very often, however, it occurs simply as a result of local injury, and is perfectly curable.

It is an affection of early life, much more common about puberty than at any other age; not very rare at earlier periods of childhood, but hardly seen after middle age. It affects more often the long bones, and especially the tibia and femur, but any bone may be the subject of the disease. It follows usually on slight injuries, sometimes from no known cause, and in these latter cases the constitutional affection is often severe, and general pyæmia may be suspected. The disease commences by the effusion of lymph between the periosteum and the bone, which is not at first purulent, but in the acuter cases soon becomes so.[1] This is accompanied by a good deal of pain, heat, and swelling, often mistaken for acute rheumatism. If the disease is acute the inflammatory effusion soon softens and forms a large abscess surrounding the bone, sometimes over its whole surface, necessarily depriving it of its nutrition, so that it dies, and often the whole shaft thus perishes in a very short time. The articular ends are usually unaffected.[2]

The treatment of this formidable affection in its acutest forms must be very energetic and decided. A free incision should be made down to the bone as soon as suppuration is detected; and if the pain and tension is severe it is well to do this even though the presence of fluid is not established. The patient must be supported during the ensuing fever and exhaustion, a sharp watch must be kept for any secondary abscesses, and they must also be opened as soon as they occur. If the bone become dead it is desirable to remove it as soon as practicable. It is neither necessary nor advisable to wait in such cases for the formation of the periosteal sheath. I have removed the whole diaphysis of the tibia,[3] and in another case several inches of the shaft of the

[1] See a case in my essay, op. cit. p. 282, footnote.

[2] The joint, however, does not always escape. A girl aged fifteen was admitted into hospital four days after an injury with great swelling of the forearm, evidently depending on the formation of matter. A grating sensation, perceived on rotating the hand, together with the history of the accident, led to the belief that fracture had occurred. She died of pyæmia; then it was discovered that a periosteal abscess, extending from the shaft of the radius into the wrist-joint, had so eroded the articular cartilages as to occasion the sensation of crepitus. There was no fracture.

[3] Mr. C. Heath has lately published another case of subperiosteal excision of the whole shaft of the tibia.—'Clin. Soc. Trans.' vol. x. p. 132. And I have recorded an interesting



FIG. 187. The entire diaphysis of the tibia, necrosed in a case of acute periostitis. The whole bone was removed by subperiosteal resection a month after the commencement of the disease. (See 'Lancet,' 1866, vol. i. p. 340.) The line (*a*) indicates where the bone was sawn across in order to remove it. The patient, a boy aged 14, recovered, with perfect use of the limb, which, however, was somewhat shortened, and the knee ankylosed.—From Holmes's 'Surg. Dis. of Children,' 2nd ed. p. 392.

the surgeon of diffuse inflammation in the soft parts; in fact, the two diseases are analogous in all essential characters.

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Fig. 188. Osteomyelitis of the femur.—From a drawing in the Museum of St. George's Hospital.



Fig. 189. Inflammation of the femoral vein from the same case.

[1] It is not absolutely necessary that the medullary canal itself should have been wounded. No doubt wounds of that canal are more dangerous than those in which only the cancelli are involved, but the latter may also be followed by osteomyelitis.

[2] The reader who wishes to follow up this question of re-amputation in cases of acute

In the central parts of the spaces so formed more or less of pus will be found, according to the acuteness of the action.

Such are the essential phenomena of the acute stages of common inflamma-

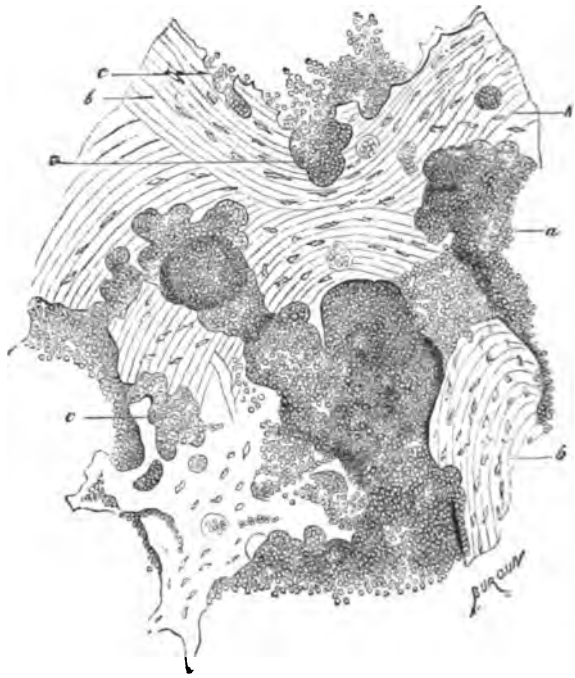


FIG. 183. Acute rarefying ostitis. *a*. Embryonic medullary tissue. The osseous lamellæ *b* are irregularly eroded and festooned by ulceration in consequence of the production of medullary cells, as shown at *c*. The preparation was made by acting on decalcified bone with chromic acid. Magnified 100 diameters. From Cornil and Ranvier.

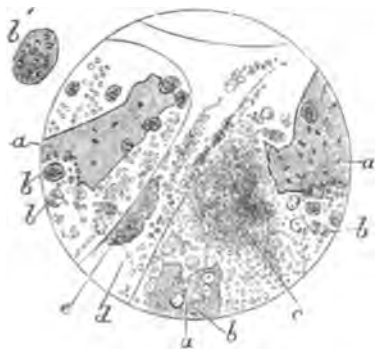


FIG. 184. Portion of a section of bone in a condition of acute inflammation. *a a a*. Bone trabeculæ. *b b*. Giant cells—so-called 'osteoclasts'—one of them is shown more highly magnified at *b'*. *c*. Pus-cells. *d*. A vein. *e*. The blood-clot in its interior.

Taken from a patient in whom I amputated the thigh on account of acute suppuration in the knee-joint. I am indebted to my colleague Mr. Stirling for the preparation.



FIG. 185. A section from the same case as fig. 184 to show the appearances at the line of junction of the bone and cartilage. *a a a*. Bone trabeculæ with the bone-corpuscles and giant-cells or 'osteoclasts.' These latter are seen eating away not only the bone-substance but also the superincumbent cartilage at the line of junction. *b*. The articular cartilage becoming calcified. At *b'* are shown the cartilage-cells with the matrix beginning to calcify around them, as staining deep blue with hæmatoxyline. *c*. An artery cut transversely. From a preparation by Mr. Stirling.

tion of bone. As this subsides, and as the inflammation passes from the rarefying, ulcerative, or destructive, to the condensing, ossifying, or reproductive stage, the cells are replaced by fibrous tissue in which bone is deposited, and

thus the condition known as sclerosis is reached. But in most cases the chronic inflammation is not preceded by any suppuration. The exact phenomena of chronic inflammation in its initial stage are not so well known, from the difficulty of meeting with it in that condition, but it may be fairly inferred that they differ in no essential respect from those above described, i.e. that the early stage consists in absorption of the earthy material caused by the proliferation of the cellular elements of the organic framework of the bone.

To this early softening stage of ostitis succeed other stages, equally analogous with the results of inflammation in soft parts, but modified by the peculiar condition of the parts. Thus the inflammatory products may pass through the stage of fibrous organisation into that of ossification, and so new bone be produced, just as it is in the union of fractures. In fact, the ordinary process of repair of fractures is that of 'first intention' in union of wounds of bone, while the repair of compound fractures exhibits the process of union by granulation. Just so after common inflammation. The leucocytes which have been effused into the intervascular spaces of the bone itself, into the cells of the cancellous tissue, medullary canal, or still more frequently the interval between the periosteum and the surface of the bone, become developed first into fibrous tissue, and next (in some cases, as it seems, almost simultaneously) the earthy constituents of the bone are deposited in this tissue, in a manner similar to that of the intermembranous ossification.

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Ostitis deformans.

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Periostitis.

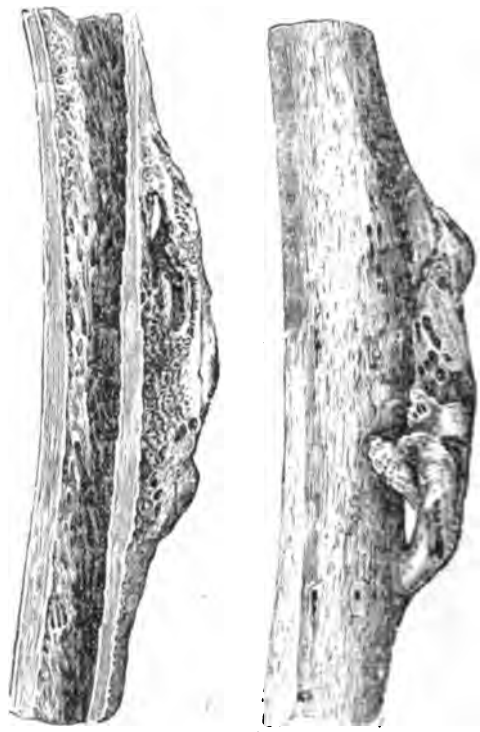
animals, even when transplanted into other parts of the body or into the bodies of other animals, will produce bone from its deeper surface. This form of inflammation is called Periostitis. It is almost always associated with more or less inflammation of the substance of the bone itself, and ought perhaps only to be regarded as one of the forms of ostitis; yet as it is always spoken of as a separate disease, it may be better for practical purposes so to regard it. Periostitis occurs in two very distinct manners, viz. the common or chronic, and the acute or diffuse periostitis.

The former is a very common affection; it occurs very often as a consequence of syphilis, and when limited to a small extent of surface constitutes the affection called Node, from the lump or 'knot' (nodus) which it produces on the surface of the bone.

Nodes.

Nodes are most common on the most superficial bones, as the cranium, tibia, clavicle, &c. They are formed of thickened and inflamed periosteum, raised up and separated from the surface of the bone by more or less fibrinous effusion. The surface of the bone is also probably inflamed. Their usual causes are syphilis, rheumatism, and struma.

The symptoms are pain in the part, increasing—as all other 'rheumatic' pains are apt to do—when the patient begins to get warm in bed, swelling and apparent softening of the affected bone, which is really due to fluid effused over it. The swelling is usually round and small, like a half-marble.



A B

FIG. 186. A internal and B external view of a preparation illustrating the ordinary anatomy of periostitis, from a well-marked example of that disease, in the Museum of St. George's Hospital.—'System of Surgery,' 3rd ed. vol. ii. p. 281.

If left alone such nodes pursue one of three courses—many are absorbed, i.e. the fluid is absorbed as the inflammation subsides and the swelling disappears; or the inflammatory effusion ossifies, and a periosteal thickening of the bone remains permanently; or, finally, suppuration follows, and an ulcerating carious surface is exposed. Syphilitic nodes occur either in the secondary or tertiary stage, and, as may be inferred from what has been said on pp. 391–2, those which are secondary are more prone to resolution or ossification, while the tertiary nodes, like other gummata, are more prone to suppuration and caries.

The treatment of nodes consists in the proper remedies for the general constitutional state, combined with counter-irritation. Iodide of potassium in moderately large doses, combined with opium, certainly seems to relieve the pain both of syphilitic and rheumatic nodes. Five grains of the iodide three times a day may be combined with 10 or 20 drops of laudanum, according to the severity of the pain, and the dose may be raised to 10 or 15 grains of the

salt if it is judged necessary. There are cases where the formation of a node, especially if the inflammation is severe and suppuration is threatening, is accompanied with so great pain that the division of the periosteum by an incision reaching from one side of the swelling to the other is called for, and this measure often gives instant and permanent relief. The ordinary cases of 'chronic periostitis,' so called, are really cases of inflammation of the whole bone, in which there is more or less deposit on its surface, which may be perceptible to the hand during life, but in which there is also induration and thickening (*'sclerosis'*) of the whole bone. The symptoms are wearing pain, heaviness of the limb, probably some increase of the temperature, little if any redness, and irregular deposit on the surface of the bone.

The only treatment which is available is the same as recommended for nodes; but it seems uncertain whether such treatment has really much specific effect on the disease, though rest and shelter and good medical supervision no doubt do much for its cure.

Diffuse periostitis. Acute periosteal abscess.

Diffuse or suppurative periostitis, leading to the condition known as acute periosteal abscess, is one of the gravest affections of bone, frequently producing a general pyæmic condition, and indeed sometimes itself only a manifestation of general pyæmia. Very often, however, it occurs simply as a result of local injury, and is perfectly curable.

It is an affection of early life, much more common about puberty than at any other age; not very rare at earlier periods of childhood, but hardly seen after middle age. It affects more often the long bones, and especially the tibia and femur, but any bone may be the subject of the disease. It follows usually on slight injuries, sometimes from no known cause, and in these latter cases the constitutional affection is often severe, and general pyæmia may be suspected. The disease commences by the effusion of lymph between the periosteum and the bone, which is not at first purulent, but in the acuter cases soon becomes so.[1] This is accompanied by a good deal of pain, heat, and swelling, often mistaken for acute rheumatism. If the disease is acute the inflammatory effusion soon softens and forms a large abscess surrounding the bone, sometimes over its whole surface, necessarily depriving it of its nutrition, so that it dies, and often the whole shaft thus perishes in a very short time. The articular ends are usually unaffected.[2]

The treatment of this formidable affection in its acutest forms must be very energetic and decided. A free incision should be made down to the bone as soon as suppuration is detected; and if the pain and tension is severe it is well to do this even though the presence of fluid is not established. The patient must be supported during the ensuing fever and exhaustion, a sharp watch must be kept for any secondary abscesses, and they must also be opened as soon as they occur. If the bone become dead it is desirable to remove it as soon as practicable. It is neither necessary nor advisable to wait in such cases for the formation of the periosteal sheath. I have removed the whole diaphysis of the tibia,[3] and in another case several inches of the shaft of the

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femur, in this condition, and satisfactory regeneration has taken place. It is to be recollected that young persons will recover in conditions which in after-life would be hopeless. I have even known recovery take place after the occurrence of pyæmic pericarditis; so that any measure which can give an additional chance should be adopted, even in very desperate cases. At the same time no such active treatment is required in the subacute cases where there is no great pain or tension and no constitutional sympathy. Here local depletion and iodide of potassium will usually lead to a cure without suppuration. Before quitting the subject I would notice that I have seen, tolerably often, the diffused swelling of subacute periostitis, particularly of the femur, mistaken for a malignant tumour.[1]

Osteo-myelitis.

When the inflammation affects chiefly or entirely the medullary cavity and the lining membrane of the cancelli the disease is called osteomyelitis. It is an affection well known by its post-mortem appearances, which show in the first stage of the disease the whole medullary membrane, including in some cases that lining the cancelli, injected, thickened, sprinkled here and there with ecchymoses, and very soon permeated with purulent extravasation. In acute osteomyelitis the disease generally proves fatal at this point. But if it does not do so, or if the action is more chronic, the matter must make its way to the exterior through some sinus, the interior of the bone will die and form a slough or sequestrum, the compact tissue being thickened and periosteal deposit formed on the surface, or the whole thickness of the bone may die (Figs. 190, 191).[2] All this forcibly reminds



FIG. 187. The entire diaphysis of the tibia, necrosed, in a case of acute periostitis. The whole bone was removed by subperiosteal resection a month after the commencement of the disease. (See 'Lancet,' 1866, vol. i. p. 340.) The line (a) indicates where the bone was sawn across in order to remove it. The patient, a boy aged 10, recovered, with perfect use of the limb, which, however, was somewhat shortened, and the knee ankylosed.—From Holmes's 'Surg. Dis. of Childhood,' 2nd ed. p. 392.

case in which the operation was successful, though a portion of the shaft was left adhering to the upper epiphysis, and the ankle-joint was freely opened by the suppuration. 'St. George's Hospital Reports,' vol. x. p. 500.

[1] Holmes's 'Surg. Treatment of Children's Dis.' 2nd ed. p. 332.

[2] See my work 'On the Surgical Treatment of Children's Diseases,' 2nd ed. p. 401, for a coloured illustration of the femur after chronic osteomyelitis.

the surgeon of diffuse inflammation in the soft parts; in fact, the two diseases are analogous in all essential characters.

The symptoms during life are not equally familiar; nor is the disease often distinctly diagnosed, except in the case of amputations, where the cut end of the medullary cavity is exposed to view. In such cases, if the medullary tissue becomes inflamed, there will be seen sprouting from the cut end of the bone a large fungous granulation, in which specks of bone can be recognised; but in other instances, where the medullary cavity cannot be examined, we must endeavour to recognise the disease by its general symptoms.



FIG. 188. Osteomyelitis of the femur.—From a drawing in the Museum of St. George's Hospital.



FIG. 189. Inflammation of the femoral vein from the same case.

These are best studied in such a case as an excision of the hip-joint or of the knee, where the cancellous interior[1] of the bone has been laid open, but the wound is buried in the soft parts. In such cases, in the acute form of the disease, the symptoms will much resemble those of pyæmia, viz. rigors and acute traumatic fever, but with the addition of more or less pain in the part and swelling of the whole limb, not due to superficial œdema. Sometimes, as in the case from which Figs. 188, 189 were taken, phlebitis is developed at the same time. If the limb be examined by a free incision down to the bone, under anæsthesia, which under such circumstances is usually justifiable, it will be found that the periosteum has receded or is receding from the bone; and if the medullary tissue can be exposed it will be found to be suppurating. Now, in the acuter cases of this formidable disease there can be no question of the advisability—in fact, the absolute necessity—of instant amputation of the limb above the inflamed bone, if the patient is to have any chance of life, for the disease has a great affinity with pyæmia, which rapidly follows in the great majority of cases, if they survive long enough for the symptoms to develop themselves completely. Unfortunately it is extremely difficult to distinguish the symptoms at the outset, and in many cases which are taken for mere osteomyelitis pyæmia has really commenced.[2]

[1] It is not absolutely necessary that the medullary canal itself should have been wounded. No doubt wounds of that canal are more dangerous than those in which only the cancelli are involved, but the latter may also be followed by osteomyelitis.

[2] The reader who wishes to follow up this question of re-amputation in cases of acute

Chronic osteomyelitis is more common than the acute form, or, perhaps, is only more commonly recognised, the osteomyelitis being passed over in acute cases as only one (and that possibly an unrecognised) phenomenon of pyæmia. It causes total disorganisation of the internal part of the bone, frequently extending through its entire thickness, and ultimately leading to death of the whole shaft for a variable length. Thus are produced those long tubular sequestra which separate from the femur or other bones after amputation (Fig. 190). This disease requires no such active or immediate treatment as acute osteomyelitis. All that is necessary is to provide for the free exit of discharges and wait until the dead bone is felt to be loose, or until the lapse of time renders it probable that it will be found so. Then the soft parts are to be freely dissected off the end of the bone, and the sequestrum twisted out with a pair of strong bone-forceps.[1]

Chronic abscess.

One of the most curious local results of ostitis is the formation of a chronic abscess in the cancellous tissue. This occurs most often in the head of the tibia—not unfrequently in its lower end, the part in which it was first discovered by Sir B. Brodie (Fig. 192)—or in the lower end of the femur. It has, however, also been noticed in many other parts of the skeleton, and occasionally occupies a circumscribed part of the medullary cavity.



Fig. 190. Upper portion of humerus exarticulated for necrosis after osteomyelitis. Amputation of the arm had previously been performed. The necrosis does not extend into the tuberosities, neck, or head of the bone, which, however, are expanded by inflammation (sometimes called osteoporosis[2]).—After Longmore, in 'Med.-Chir. Trans.' vol. xlviii.



Fig. 191. A femur showing the whole shaft in a state of necrosis after osteomyelitis from injury. x, y show the limits of the necrosis. The sequestra (which do not extend into the epiphyses) are visible through the cloacæ. —After Longmore, *ibid.*

The symptoms are obscure and the diagnosis is formed more by their persistence and by their resisting the treatment which usually relieves rheumatic pain in the bone than by any striking pathognomonic sign. There is constant wearing pain referred to the part, with little or no external

osteomyelitis following an operation on bone is referred to Sir J. Fayrer's 'Clinical and Pathological Observations,' pp. 48–94; and to some observations of mine in 'Surg. Dis. of Childhood,' 2nd ed. p. 536, and 'St. George's Hospital Reports,' vol. i. p. 152.

[1] On the subject of osteomyelitis a paper by Mr. Longmore, in the 48th vol. of the 'Med.-Chir. Trans.' will well repay perusal, both as a clear statement of the symptoms of these two forms of osteomyelitis or diffuse inflammation of bone occurring after gunshot wounds, and as a proof of the success of the expectant treatment in the milder form.

[2] It seems to me better to restrict the term 'osteoporosis' to the non-inflammatory hypertrophic condition described in a subsequent section; but the word is often used to describe the results of inflammation also.

inflammation, perhaps a little enlargement, and usually some local tenderness. When the abscess lies very near the cavity of a joint the inflammation may be propagated to the joint, giving rise to occasional attacks of synovitis, and in such cases there is considerable risk that the abscess may burst into the joint, and so lead, in all probability, to the loss of the limb or joint (Fig. 193).

The abscess is almost always seated superficially, covered by little more than the cortical part of the bone (which perhaps may be somewhat thickened by inflammation, as in Fig. 194), and it seems to be due in most cases at any rate to contusion of the surface. In a striking case which occurred to me some years ago, the disease dated from a contusion by spent shot received at the battle of the Alma, more than fifteen years previously. In some of these cases the abscess contains a nodule of dead bone, and it seems very probable that in such cases a portion of the interior of the bone has been so far detached from the neighbouring parts as to have perished. There are, however, many cases in which there has been no injury whatever, and where the affection must be attributed to inflammation of a rheumatic nature, the result of cold.[1] The pus may remain encysted in the cavity for a very long period, possibly for the whole of life, since one of the earliest effects of the inflammation is to produce hardening ('sclerosis') of the bony walls of the cavity. But in other cases it does slowly make its way either to the cutaneous or the articular surface (Fig. 193), and I have known a case in which on turning down the periosteum a small opening was perceived leading into the abscess.



Fig. 192. Chronic abscess in the lower end of the tibia, from the original case, in which Sir B. Brodie first described this affection. (See his works, vol. iii. p. 44.)—St. George's Hospital Museum, Ser. ii. No. 30.

It is of great importance to diagnose this affection with at any rate such an approach toward certainty as will justify the surgeon in applying the trephine. When once the abscess has been opened the pain will cease, the cavity slowly fill up, and the patient be restored to perfect health. Mr. Carr Jackson (op. cit.) justly relies principally on the severity, the continuance, and the paroxysmal character of the pain, and on the localised tenderness, sometimes referred to a single definite spot, pressure on which gives rise to the most agonising sensation. It must be admitted, however, that the diagnosis is not easy. Sir B. Brodie relates a case in which he applied the trephine and found no pus; Mr. C. Jackson recorded a similar instance, and one lately occurred in my own practice. In all these cases it is true that the operation did good, and it may be conjectured either, as Mr. Jackson seems to think, that there was a minute quantity of pus, which was not seen at

[1] See the third case in Mr. Carr Jackson's pamphlet, 'On Circumscribed Abscess of Bone,' London, 1867.

the operation, but the evacuation of which relieved the pain, or that the relief was due to the incision of the tense and indurated periosteum and shell of the bone. In such cases, however, there has been, at any rate, ostitis, and the treatment by incision is a rational one whether necessary or no. But there can be no doubt that, in many instances, the mistake has been made of taking what is merely a neuralgic or hysterical affection for abscess of bone. Therefore the greatest care should be taken by the surgeon to assure himself of the reality of organic lesion, or at least to have the strongest evidence of it before undertaking an operation which is certainly serious, though not often fatal. The operation is a simple one. The surgeon, as Mr. Jackson recommends, would do well to mark out on the skin previously the precise spot to which the pain or tenderness is referred. The patient being fully narcotised, a crucial incision should be made down to the bone, the periosteum turned down by a similar crucial incision, and the trephine applied to the spot marked. If no pus be found it is well



FIG. 193. Drawing of the lower end of the femur from a case of excision of the knee. An abscess which has formed above the position of the epiphysial line has made its way into the joint. The cartilages are seen ulcerated. A probe passed through the track of the abscess shows its opening into the articular cavity.—From a drawing in the Museum of St. George's Hospital, Ser. xxi. No. 55 B.[1]



FIG. 194. Unsuccessful trephining in abscess of bone. *a*. The point where the trephine was applied, about half an inch from the abscess. *b*. The wall of the bone, thickened by inflammation. *c*. The cavity of the abscess. *d*. The pyogenic membrane. St. George's Hospital Museum, Ser. ii. No. 31.—From 'Syst. of Surg.' 3rd ed. vol. ii. p. 288.

to perforate the walls of the trephine-hole in various directions with a bradawl or small chisel, in order to see whether the matter may be situated in the immediate neighbourhood. This was the case in the patient from whom Fig. 194 was taken. The trephine has been applied close to the collection of matter, but the latter was not opened, and the patient remained unrelieved till his death.[2]

[1] I would here take the opportunity of referring the reader, on the subject of these abscesses forming near the joints in childhood, to an interesting paper by Mr. T. Smith, 'On the Acute Arthritis of Infants,' in the 10th vol. of the 'St. Bartholomew's Hospital Reports.' The subject will be resumed in the next Chapter.

[2] Or possibly till the limb was amputated. In the hospital catalogue it is said that 'the patient died some short time afterwards, and the abscess was then discovered.' Yet Sir B. Brodie alludes as follows to an exactly similar case, and Mr. Carr Jackson says that this preparation is taken from that case: 'A very experienced hospital surgeon applied the trephine for a supposed abscess in the head of the tibia. No abscess, however, was discovered, and in consequence the limb was amputated. On the parts being examined afterwards the abscess was discovered at a small distance from the perforation made in the operation, and it was plain that the removal of a small portion more of the bone would have preserved the patient's limb.'

The figure illustrates almost every point in the surgery of the disease—the small cavity in the head of the bone, lined (as these abscesses almost always are) by a very definite pyogenic membrane, the slight tumefaction of the bone caused by the thickening of its periosteum, the induration of the bone around, and the tendency which the matter has to make its way, however slowly, to the surface, for all the bone which covered the matter has been removed at one point, and the wall is formed by the thickened periosteum only.

Caries.

The term 'caries' is used in the context as being synonymous with 'ulceration of bone,' just as necrosis is used as synonymous with gangrene of bone. Some pathologists make a difference between carious ulceration and healthy ulceration of bone, and in the writings of these authors the term is used in the same sense as we use 'strumous caries.'



Fig. 193. The head and upper part of the shaft of the humerus, extensively ulcerated. The head is in great part destroyed. A transverse fracture of the shaft of the bone has taken place immediately below the head. Below the part where the shaft of the bone has been broken a considerable amount of new bone is thrown out in the neighbourhood of the fragments, which are only slightly displaced. The medullary canal is open throughout. —St. George's Hospital Museum, Ser. ii. No. 46.

Caries is the stage which succeeds to the softening stage of ostitis,[1] when the inflammatory process pursues its course towards disintegration instead of being arrested and repaired, in which case it is followed by condensation, or sclerosis. The inflammatory exudation breaks down into pus, the connection between the solid particles of the bone and their fibrous stroma is dissolved, and the bony particles are removed in imperceptible portions in the discharge. When the disease occurs on the surface of the bone the periosteum will be found to be thick, and loosened from the bone; in the more advanced stage of the disease it is converted into a villous mass of a pink colour resembling a mass of granulations. When this is raised from the bone the latter will be found excavated into pits, into which this granulation-tissue dips, and around these pits the bone is softened and rarefied by inflammation. Other neighbouring parts of the bone may, on the contrary, be enlarged and hardened, the inflammation there having shown itself in the reproductive form. Most of these points are illustrated by the accompanying engraving, which shows the deep pits worn into the tissue of the bone, the change of shape of the head, the attenuation of the shaft, so that it has given way at one part, and the attempt at reproduction or consolidating inflammation in the neighbourhood of this injury.

Strumous caries differs from ordinary caries less in essentials than in degree; there is more softening, less attempt at repair, more extensive disin-

[1] The softening stage of ostitis itself is what the German pathologists sometimes intend by the term 'caries,' so that a bone in the condition shown by Fig. 184, on p. 412, would in the language of Virchow and Volkmann be called an instance of 'caries sicca.' Billroth uses the term 'caries' or 'ostitis, fungosa' or 'granulosa' indiscriminately to describe this condition. The objection to the term 'caries sicca' is obvious. Pus has not formed; but in the great majority of instances it will form—while the term 'sicca' seems to imply the contrary. I cannot see the use of multiplying these lumbering dog-Latin words.

tegration of the neighbouring bone. In some cases there is a distinct deposit of tubercle in the cancellous tissue, but this, I think, is not common; the cheesy masses which are seen sometimes in the head of the tibia, the bones of the tarsus, the vertebræ, and other large porous bones, are regarded with more probability, I think, by some of the best pathologists as collections of lymph or inspissated pus. I ought to add, however, that much difference of opinion prevails on this subject.

The symptoms of caries are merely those of inflammation of bone with an abscess or sinus leading down to exposed, softened, rough bone, which bleeds readily under the touch of the probe. The discharge has sometimes the fœtid offensive smell of putrefying bone, but by no means always. The chemical character of the discharge is said in some cases to assist in the diagnosis by showing a larger quantity of phosphate of lime than is contained in matter derived from soft parts;[1] but if these observations be allowed to be correct, the fact is hardly clear enough to afford a basis for satisfactory diagnosis. Indeed, in deep-seated caries the diagnosis is often only inferential; i.e. no other cause can be assigned for the persistence of discharge, with perhaps some pain or symptoms of inflammation around the bone. Often, also, the prominence of the granulations around the opening of a sinus gives indication of the presence of an abiding source of irritation below, which, if not a foreign body, can hardly be anything except a piece of dead or diseased bone.

Healthy ulceration of bone is constantly repaired, and even in strumous ulceration repair may occur when the disease is not too extensive. The ulceration gives place to condensing inflammation; the bones, if more than one is affected (as in the spine and tarsus), grow together by bony ankylosis; new bone is thrown out to defend and support weak parts, and there results a hard, irregular mass of bone, often much more solid than the parts which it has replaced.

This is well illustrated in the repair of caries of the spine, leading to angular curvature.

The treatment of caries must often be expectant merely, as in the instance just given of carious spine, where no application to the ulcerated surface is possible, and many good surgeons are inclined to believe that the expectant treatment is the best in almost all cases, whatever the situation of the disease. However, it is undeniably tedious, and either the urgency of the patient or the impatience of the surgeon often leads him to endeavour to accelerate matters; and this is the more reasonable in cases where neighbouring parts may be involved in the progress of the disease, as in the case of diseased bone in the tarsus, where the disease, if not early treated, may very probably extend from one bone to another till the whole foot is incurably diseased.

The methods of local treatment are various. The most common one is to expose the diseased bone and to remove as much as is found to be diseased with the chisel, gouge, or some other cutting instrument, until a surface of bone is reached sufficiently healthy to take on reparative action; and this plan is often successful, particularly when the ulceration is of a healthy nature, as in that which follows on accidental injuries. But it is liable to the danger of extending the disease instead of stopping it, by the inevitable contusion and crushing of the portion of bone left behind. M. Sédillot has proposed a method, to which he gives the name of 'évidement des os,' by which the whole inflamed and softened bone is to be gouged out from its periosteal

[1] Bransby Cooper's 'Lectures on Surgery.' Barwell, 'Dis. of Joints,' 1st ed. p. 238.

sheath, leaving nothing but the soft parts from which the bone is to be reproduced. I have no experience of this method, believing the total extirpation of bones which are so completely disintegrated as to require such a plan of treatment to be preferable. Most of the excisions of joints and resections of bones which are performed are necessitated by caries of the bones which has entirely destroyed the utility of the part; but before so grave a step is taken it is desirable to try all appropriate means of local treatment. In aid of the treatment by rest (or the expectant treatment) various local applications are in use for removing the ulcerated bone and exposing sound tissue by a process less dangerous than gouging to the integrity of the bone left behind. The most successful of these is, I think, the application of sulphuric acid, after the manner described by Mr. Pollock, in the 'Lancet,' May 28, 1870. The carious bone being thoroughly exposed by incision or removal of the soft parts which cover it, a solution of equal parts of sulphuric acid and water is applied to it with a glass brush, or a lotion of five or six parts of water to one of the strong acid is kept in constant contact with the bone by impregnating a piece of lint with it and pushing it down to the diseased part. The former plan is the more efficient when the carious surface is superficial. The strength of the acid is gradually raised till at length it is applied pure. As the diseased bone is dissolved out healthy granulations spring up here and there till the whole surface seems healthy, when it may be left to heal.

Dr. Kirkpatrick[1] effects the same object by the caustic action of Vienna paste (potassa cum calce). He destroys the soft parts with this paste till a large funnel-shaped opening is left, leading down to the bone, which is then to be perforated with a strong knife, chisel, or trephine, and into these perforations the caustic is to be introduced. As the bone which is thus destroyed and cauterised comes away, the parts around are consolidated by healthy inflammation. This plan is more easily applied to deep-seated caries than the sulphuric acid treatment, but is otherwise, as far as I have seen, less successful.

Other local applications are the actual cautery, which, however, can only be used in rare cases in which the whole carious surface is exposed, and seems to me less energetic and penetrating than the acid—the injection of iodine, much recommended at one time but now fallen into deserved disrepute, and injections of dilute mineral acid, which, however, are superseded by the more methodical use of the strong acid. Solutions of iodoform are now employed, and it is said with some success.[2]

Phagedænic ulceration of bone.

I need only refer here in the most cursory manner to cases in which the inflamed bone is removed with great rapidity. Mr. Stanley[3] describes this under the name of 'phagedænic ulceration of bone,' likening it to the phagedæna of the soft parts; but Mr. Stanley's cases appear to have been instances of epithelioma or rodent ulcer. Mr. Cæsar Hawkins[4] has recorded two striking cases of extensive destruction of the bones of the head, accompanied, in one instance by suppuration, in the other not, which shows how

[1] 'Dub. Quart. Journal.' 'New Syd. Soc. Bien. Rep.' 1867–8, p. 259.

[2] I ought possibly to mention that Hueter uses injections of dilute carbolic acid into the bones themselves, by means of a perforated trocar driven into their substance, in cases of assumed osteomyelitis, especially when believed to be tubercular. I have tried this plan once, but unsuccessfully.

[3] 'Diseases of the Bones,' p. 65.

[4] 'Med.-Chir. Trans.' vol. xxxix. 'Contributions to Pathology and Surgery,' vol. i. p. 349.

rapid sometimes is the absorption of inflamed bone. But the cases of this disease are so rare that I must content myself with this brief mention of it.

Necrosis.

Necrosis, or the total death of a considerable portion of bone, is distinguished from caries, or the ulceration of the bone and its disintegration in invisible molecules, just as the gangrene or death of a visible portion of the soft tissues is distinguished from ulceration, or 'molecular gangrene.' The phenomena of necrosis, also, are strictly analogous to those of gangrene. It may be produced, as gangrene is, either by inflammation or by loss of blood-supply or by chemical disintegration of the tissues; but in the bones inflammation is a far more common precursor of necrosis than it is in soft parts; in fact, the cases where necrosis does not depend on inflammation are only exceptional, while in the soft parts, though inflammation usually bears its part in inducing gangrene, yet other causes almost always co-operate. The reason of this is obvious: the soft parts easily accommodate themselves to the enlargement of the vessels and to the intervascular effusions which are necessary accompaniments of inflammation, whilst in the bones the vessels are confined in rigid canals; and any such attempt at expansion being checked at once, the circulation comes to a standstill. The dead bone then turns white (unless it is exposed to the air and bathed in the products of putrefaction, when it may be perfectly black); if cut into it will not bleed; the periosteum and soft parts recede from it, leaving its surface smooth, hard, and ringing when struck; the living bone in the neighbourhood becomes inflamed, leading to condensation of its tissue for some distance, and to periosteal deposit, both on the surface of the living bone and especially over the dead bone, so that the dead bone is roofed in or *invaginated* (as the technical term is) by a cover or sheath of living periosteal bone. While this is going on the irritation of the dead bone sets up inflammation in all the parts with which it is in contact, viz. the living bone and the deep surface of the periosteum. The pus so furnished finds its way to the surface through the sheath of new bone, which thus is interrupted by holes or sinuses, through which the pus burrows to the surface of the body. These sinuses are technically called *cloacæ*, and the piece of invaginated dead bone thus sequestrated from the soft parts is called a *sequestrum*. When the periosteum is destroyed there is usually no sheath, though it is possible that new bone may be produced by the soft parts. This, however, is a far slower and more imperfect process. When there is no sheath and the dead bone is exposed on the surface the process of separation and the piece of dead bone which separates are both described by the name of *exfoliation*. As the inflammation proceeds it digs a trench around the dead bone by a line of demarcation, as in the soft parts, and thus the sequestrum becomes loose in its cavity, and if the cloacæ are large enough it may escape through one of them. But this rarely happens, and for the most part it is necessary to enlarge the opening of the cloaca before the sequestrum can be removed.

This description applies to necrosis of the superficial part of the bone, and this is by far the most common situation. Central necrosis, however, is occasionally, though not very frequently, met with, as the result of inflammation of the medullary tissue, possibly caused by contusion of the substance of the bone. The symptoms are very obscure, and are, in fact, usually merged in those of chronic abscess; since the resulting inflammation, supposing the affection to be seated in a part such as the head of the tibia (where there is abundance of cancellous tissue), will set up suppuration around the dead bone.

In the shafts of the long bones the same thing may occur. The pus will become diffused among the meshes of the medullary tissue, and the disease has been known to be many years in progress before the dead bone has become loose.[1]

Suppuration may be long delayed in cases in which the necrosis is the result of chronic ostitis—'for months and possibly even years'—and in such cases there is considerable resemblance to malignant disease, especially as spontaneous fracture may occur. In these cases the necrosis attacks the substance rather than the surface of a bone, and the new bone which will ultimately invaginate the sequestrum is furnished by the endosteum as well as the periosteum. The reader is referred to an interesting paper in vol. lx. of the 'Med.-Chir. Trans.,' by Mr. Morrant Baker on 'Necrosis without Suppuration.'

The bones most subject to necrosis are those which are most exposed to the various causes of inflammation, of which syphilis, struma, and local violence are the commonest. Hence the superficial bones are found affected more commonly than those which are further removed from participation in the various affections of the surface. The cranium, the tibia, the clavicle, the bones of the forearm and hand, are most commonly the subjects of the affection; but it is by no means uncommon in the femur or humerus. The denudation of the bone by destruction of its periosteum is very frequently followed by necrosis, but not always, since the exposed bone may derive sufficient nutriment from the neighbouring parts of the bone,

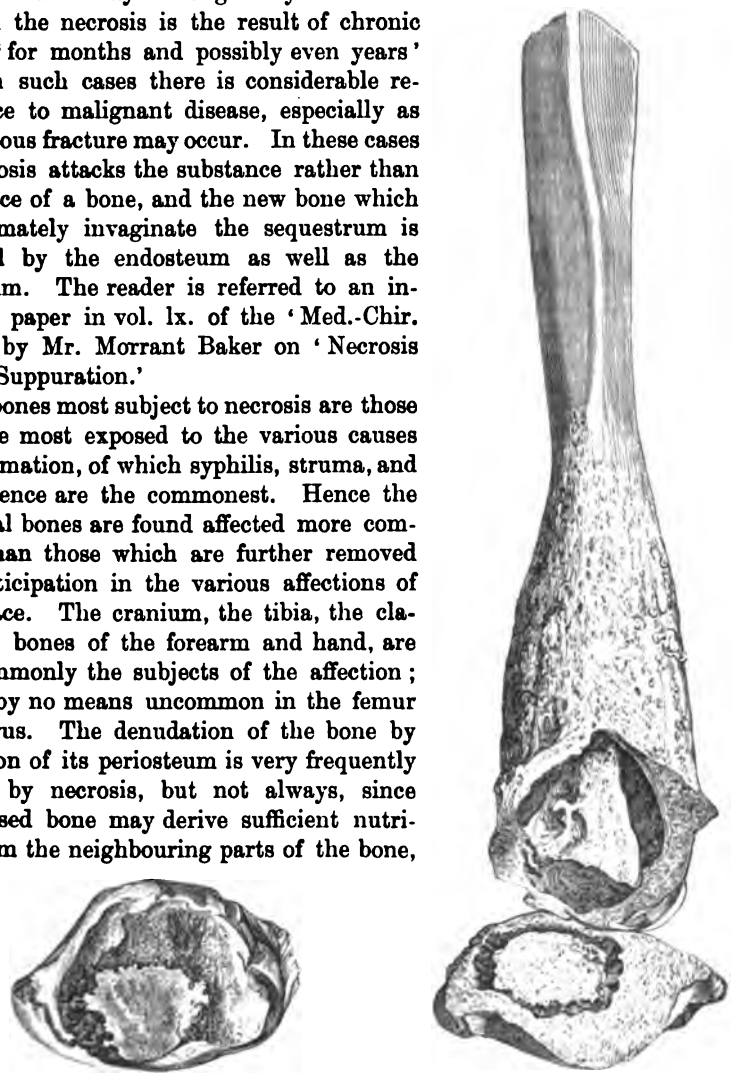


Fig. 196. Necrosis of the lower part of the shaft, and epiphysial extremity of the tibia. The larger figure shows the sequestrum surrounded by its sheath of new bone, the latter gradually merging above into the healthy surface of the bone. A section has been made through the sequestrum and its cavity near the articular surface. The smaller figure shows the articular end of the bone, where the extremity of the sequestrum is seen, surrounded by an ulcerated surface of bone, from which the articular cartilage was completely removed. The sequestrum was here perfectly accessible, and could have been removed by a free incision into the joint.—From a drawing in the Museum of St. George's Hospital, presented by Sir B. Brodie.

and to some extent from the neighbouring soft parts, to preserve its vitality. Thus after a severe scalp-wound large portions of exposed bone may be seen to become gradually vascular, small granulations springing from the

[1] In the Museum of St. Bartholomew's Hospital, Ser. i. No. 176, is a specimen of a femur removed by amputation, in which there was a small necrosed portion of the inner layers of the medullary cavity. The bone had not separated, though the disease had been in progress for thirty-five years.

surface here and there, and ultimately forming a cicatrix by which the whole is covered, without any visible exfoliation. And in the bones of the face large denudations of the periosteum are perfectly compatible with the regular nutrition of the bone. Thus, in the operation for cleft of the hard palate, the surgeon denudes the bones of their periosteum, without any apprehension whatever of necrosis. But in bones which are less vascular than those of the head and face, or in bad conditions of health, or where the denudation is very extensive, the outer table of the bone will usually exfoliate, though not to so great an extent as would at first appear probable. The soft parts almost always adhere around the edges of the wound to some extent, and preserve the life of the circumferential portions.

Acute necrosis.

Necrosis sometimes occurs with almost as much rapidity as gangrene of the soft parts, and then the constitutional disturbance may be great, and pyæmia is very likely to ensue. I have spoken of this in connection with diffuse or acute periostitis, which is the common cause of acute necrosis. The next most common cause is destruction of the periosteum and injury to the surface of the bone, either by contusions, chemical injuries, or fire. But there are rare cases in which acute necrosis ensues from obscure causes, and without any visible affection of the periosteum or medullary membrane, of which I have related a striking instance in the essay already referred to in the 'System of Surgery' (p. 302). Such cases must be treated in the same way as those of acute periostitis.

Treatment of necrosis.

The treatment of necrosis is, as a general rule, to wait until the bone is loose and then to remove it. In the case of an exfoliation nothing more is necessary than to lift out the loose portion by putting an elevator beneath its edge and extract it with a pair of forceps. Very often when the soft parts lock-in the exfoliation it becomes necessary to cut the loose part across in order to remove it piecemeal, and this is effected by a pair of cutting forceps or bone-scissors.



FIG. 197. Extensive ulceration of the tibia and fibula, with necrosis. Both bones are much thickened by inflammation, and covered with a deposit of new porous bone. The large irregular cavity which is seen in the tibia has resulted from the necrosis and removal of the whole thickness of the shaft of the bone, with the exception of two small bridges or pillars, which extend from the upper to the lower end of the tibia. The tibia is firmly soldered to the fibula, above, below, and opposite to the cavity.—From a preparation in St. George's Hospital Museum, Ser. ii. No. 51.

But under certain circumstances this usually simple operation becomes a very complicated, difficult, and dangerous proceeding. The most familiar instance is in that necrosis of the popliteal space of the femur which occurs so often, and in which, for some not very obvious reason, there is rarely, if ever, any periosteal sheath, so that the exfoliated bone lies close under the popliteal artery, and may easily wound it, as happened to a young man the subject of this affection, who in dancing ran the loose splinter of bone into the popliteal artery and bled to death.[1] The same accident may occur in removing

[1] Byron, in 'Med.-Chir. Rev.' vol. xxiv. p. 259. Jacob, 'Diss. Med. Chir. de Aneur.' Edin. 1814.

the bone, or the knee-joint may be opened, or the artery may be wounded by the knife, trephine, or cutting pliers. It is necessary, therefore, to proceed with great care, making the incision on the outer side and somewhat to the back, so as to avoid the synovial membrane, yet not to wound the external popliteal nerve; then to dissect with great care along the back of the femur, and use the bone-scissors, if necessary, with great caution. In withdrawing the bone all rough manipulation should be avoided, and the parts scratched and pushed off it with the finger-nail and handle of the scalpel in preference to any cutting instrument. Esmarch's bandage is of great use in operations of this kind.

When the dead bone is invaginated it is necessary, in the first place, to endeavour to ascertain whether it is loose; but this is by no means easy. The length of time during which it has been exposed will of course justify a guess—but only a guess—for the period at which the dead bone separates depends on many causes of which the surgeon can hardly have any knowledge, and in great part on the acute or chronic nature of the original action. Still, if the disease has been long in progress, and there is not much risk in cutting down on the bone, it should certainly be done, if only to get a perfect knowledge of its condition. The sequestrum may be quite detached from the bone around it, yet so locked in that no movement can be impressed on it by the probe. Sometimes the groove of demarcation between the living and dead bone can be felt, and if so it is a valuable sign that the sequestrum is loose. The operation consists in freely exposing the invaginating bone with its cloacæ, and enlarging one or more of the latter by cutting the new bone away, either with the trephine applied round one of the openings, or by cutting through the bridge between two neighbouring cloacæ with chisel or forceps, and so obtaining free access to the sequestrum, which is then to be taken out with the forceps, or, if too large, to be cut through with the cutting pliers, trephine, or any handy instrument, and so removed. The surgeon must be careful to leave none of the dead bone behind in the cavity. The wound need not be closed, since it can only fill up by granulations. The discharge is often most putrid, and the pit in the bone requires for some time to be very freely washed out with some disinfecting solution.

It used to be recommended in surgical lectures to defer this operation till the periosteal sheath might be presumed to have acquired strength enough to preserve the continuity of the limb, but this is not now considered advisable. In the leg and forearm, where there is a second bone, the periosteal inflammation will be sure to unite the affected to the sound bone, if the necrosed portion be at all large (see Fig. 197); and even if this does not occur, or if there is only one bone, it seems better to remove the sequestrum at once, since it is a permanent source of irritation, and to trust to careful splinting and bandaging to maintain the parts in position and prevent any fracture. However, it cannot be denied that the danger of fracture from necrosis is a real one, and particularly if the neighbouring bone has been cut away to some extent; and when this accident has happened in the case of the femur, amputation will usually become necessary (Fig. 198). In the arm careful treatment will probably preserve the limb.

Fracture from necrosis.

Some other plans of dealing with necrosed bone are occasionally useful. They consist chiefly in applying chemical solvents, by which the dead bone may be dissolved out and thus its removal be effected more quickly than by waiting for its separation. Of these the sulphuric acid is the best (see page 423), and by its means I have seen large portions of the skull removed, and

certainly with the effect of much diminishing the fœtor of the discharge. The difficulty is when the limits between the dead and the living bone are reached, since any substance strong enough to dissolve the tissue of the bone may easily kill the living but inflamed bone in the neighbourhood of the exfoliating portion.



FIG. 198. Fracture in consequence of necrosis, necessitating amputation, from which the patient (a boy, aged 15) recovered. *a* refers to the necrosed bone; *b* to the new bone, which (along with the remains of the old shaft) has given way. The patient had had diseased bone for more than four years, and had been frequently operated upon. At length he again came into the hospital in 1861. The femur was trephined and some more dead bone removed. He went on well, and the wound was nearly closed, when, six weeks after the operation, he fell in running across the ward and fractured the thigh. It was put up in the usual way, but no union could be procured. The wound discharged a large quantity of thin unhealthy pus, and it became necessary to amputate. The fracture has passed through the trephine-hole, a part of the outline of which is seen on the necrosed bone. The artery lay to the inner side of the broken ends —it was uninjured. The interspace between the fragments was filled with white fibrous tissue, in which many ossifying specks were visible under the microscope.—St. George's Hospital Museum, Ser. II. No. 100.



FIG. 199. Necrosis of the whole shaft of the tibia, from a patient aged 18. The upper epiphysis is unaffected, but the disease extends into the ankle-joint, and a small loose portion of bone can be seen on the lower articular surface. The patient was originally admitted in the year 1838, the disease having then existed for four years, and being referred to an accident. Some dead bone was then removed, and he was sent into the country, as his health was failing. Next year he was readmitted, and the greater part of the necrosed bone was extracted, through the large aperture (made by the trephine and other instruments) seen at the upper part of the shaft of the bone. Numerous other openings are seen, most of which are cloacæ, one of them of a rounded form, probably the former trephine-hole. The lad died shortly after the last operation from another cause.—St. George's Hospital Museum, Ser. II. No. 80.

Complications.

The complications of necrosis are very numerous; but as the majority of them are merely the results of inflammation propagated from the inflamed bone to the soft parts in its neighbourhood, and are marked by the symptoms peculiar to such inflammation, it would be impossible to speak of all of them here, nor would it be necessary. It may perhaps, however, be proper to take

notice of the fact that necrosis is not an uncommon cause of destructive inflammation of joints. Usually, indeed, the inflammation of the shaft of a long bone is not communicated to the articular end, but this is not always the case. The articular end itself may share in the death of the shaft, or the suppuration which is excited by the sequestrum may perforate the articular lamella, and make its way into the joint, as in Fig. 199; or, again, the necrosis may be confined to the articular end, the shaft being free, so that the whole or a portion of the epiphysis may become loose in the joint and act as a foreign body. The joint under any of these conditions must be considered, as a general rule, to be destroyed, and it becomes merely a question whether amputation is necessary or excision may be ventured on, or the loose bone only be extracted by incision into the cavity of the joint, and the latter left to ankylose.



Fig. 200. Scrofulous tubercle deposited in the head of the right femur. 'The cartilages had been destroyed by ulceration, and the bones were in a state of caries.' The section of the bone shows a large mass of yellow substance deposited in the cancellous tissue.



Fig. 201. Deposit of tubercle in the head of the left femur from the same case as the preceding. No disease had been supposed to exist in this joint before death, and the drawing shows the cartilage and ligamentum teres intact, but the bone was softer than natural, and its vascularity increased.—From drawings presented by Sir B. Brodie to the Museum of St. George's Hospital. The case (that of Captain D. case xxxi.) is to be found in his 'Treatise on Diseases of the Joints,' Works, edited by C. Hawkins, vol. ii. p. 196.

Scrofula in bone.

I must now give a very brief account of the modifications of the inflammatory process caused by the various constitutional cachexiæ.

In *scrofulous* disease of the bones there is sometimes seen a deposit of crude cheesy tubercle in the cancellous tissue; the articulating ends (Figs. 200, 201), or the short bones, are the most common seat of this deposit. More commonly, however, strumous disease in a bone produces merely a low inflammatory condition, in which the bony tissue is so softened as to be easily cut with a knife; the cancellous portion of the bone is looser and lighter than natural, and its cancelli filled with fluid, the product of inflammation, sometimes mixed with pus, and the compact tissue thinned and rarefied. On microscopic examination the lacunæ and canaliculi are found filled with exudation, and occasionally minute bony projections from the walls of the dilated cancelli indicate an attempt at the reproduction of bone, and that healing by sclerosis which has already been described as one of the usual events of healthy inflammation.[1] The leading features, then, of the pathological anatomy of strumous inflammation are the same as those of ostitis in general; and the

[1] See Black, 'On the Pathology of Tuberculous Bone,' Edin. 1859.

only distinctive anatomical peculiarity consists in the nature of the exudation which chokes up the spaces in the bone. Dr. Black has given several analyses tending to establish these four conclusions—that tuberculosis gives rise to (1) a considerable increase of fat in the diseased bone; (2) a large diminution of the salts of lime; (3) a diminution of the organic matrix; and (4) an increase of the soluble salts.[1] In general terms, strumous is distinguished from common inflammation by the softness, lightness, and oiliness of the affected bone, by the greater diffusion of the morbid changes, and by the less tendency to cure. The obvious effect on the bone consists either in chronic enlargement without suppuration, or in inflammation followed by ulceration or caries. The former is sometimes, though with doubtful correctness, called 'a strumous node.' It differs from the common nodes, which are usually syphilitic, in the fact that they are often purely periosteal, while the strumous node hardly ever is so. It is formed by enlargement and expansion of the bony tissue, in part, but also, and generally in greater part, by engorged and infiltrated soft tissues. Such strumous enlargements or nodes sometimes remain indolent and without much change for a long period. They are chiefly seen in the articular ends of the bones, sometimes in the clavicle or skull, and occasionally in any other bone. The more active inflammation which tends to softening and suppuration (strumous caries and necrosis) is very common in the joints, in the foot, and in the spine, but is met with in all parts of the body. It is not accompanied by much pain, unless from irritation of nerves lying near the diseased bone, and is remarkably obstinate, seldom stopping until the whole of the affected bone has become disintegrated. The necrosis is generally induced by the caries—i.e. a portion of bone perishes in consequence of the disintegration of some neighbouring part from which its vessels are derived, so that the removal of the dead part does not stop the disease. So obstinate is this strumous caries, that Mr. Syme spoke of it as an incurable affection; but this seems going too far.

Strumous nodes.

Strumous caries and necrosis.

The treatment of strumous disease in bone should be chiefly expectant, as far as the local disease goes. Strumous nodes will sometimes disappear rapidly under the iodides—especially iodide of iron—combined with constitutional treatment. Country, especially sea, air is of great importance in such cases. When suppuration has occurred, and carious bone is exposed, its separation may be hastened by caustic applications, such as sulphuric acid or the actual cautery; but, after all, such local measures can only be regarded as adjuvants to constitutional treatment. When the bone is greatly disintegrated its removal by excision or amputation becomes necessary.

Syphilis as it attacks the bones in adult life leads either to periostitis or to ostitis, caries, and necrosis. Enough has been said above on the subject of nodes, and I must refer the reader to the previous pages and to the chapter on SYPHILIS for all that seems necessary as to caries and necrosis. I will add here a few observations on the usual forms of syphilitic ulceration, as contradistinguished from the other forms of ulcer which we find in bone.

Syphilis in bone in adult life.

Mr. Stanley says that 'the varieties of ulcer in bone are as distinctly

[1] I ought to add that many pathologists speak of the formation of tubercle in the bone as being a very common phenomenon. See Macnamara, 'Dis. of Bones and Joints,' Lect. iv. Much depends on the definition given of tubercle. Some regard all inflammatory products which lead to caseation as tubercular; others seem to make the presence of giant-cells in the inflammatory deposit the test of its tubercular nature.

marked as they are in other tissues.'[1] Without going quite so far as this, I think there can be no doubt that there are specific differences between certain forms of ulceration in bone which are recognisable from each other, though there are many forms of ulceration in which the most acute pathologist would be unable to say from an inspection of the ulcer what the constitutional condition had been on which it depended.

Syphilitic ulceration occurs in two chief forms, which bear an analogy to the affections of the skin in constitutional syphilis, as Paget has pointed out in the Catalogue of the Museum of the College of Surgeons. They are the *annular* and the *tuberculated*; the former likened to the rupial ulcers of the skin, and the latter to the syphilitic tubercle.[2] In the annular ulceration 'a small round spot is seen where the surface of the bone is worm-eaten from the presence of numerous minute depressions, and in some cases the bone around this worm-eaten central portion is marked by arborescent grooves, the traces of increased vascularity. Later on a circular trench is marked around the worm-eaten spot, and as this widens and deepens it undermines and finally chisels out the piece, which separates as a sequestrum, and then the bone scars over, leaving a rounded depression much larger than the original spot.' The tuberculated form 'appears to commence by a tubercular thickening of the external wall of the bone, due not to periosteal deposit, but to chronic inflammation of the compact tissue itself. This inflamed bone soon becomes dotted over with numerous little pits or depressions, which coalesce and form ulcers, usually oval or round, penetrating deeply into the interior of the bone.' As subvarieties of syphilitic ulcer Sir J. Paget has described (1) the *reticulated*, in which the disease commences by reticular deposit of periosteal bone, which then becomes perforated by annular ulcers; so that this seems to be a mixture of secondary and tertiary syphilis—a node perforated by ulceration; and (2) the *penetrating*, in which the whole thickness of the bone is removed to a considerable extent by one or other of the previously described forms of ulcer.

The main peculiarities of syphilitic as distinguished from the other forms of ulceration in bone would appear to be its tendency to assume the annular or crescentic form, together with the circumscribed (and often also circular) induration or tuberculation of the exterior of the bone. Simple ulceration, on the other hand (of which perhaps the best examples are to be found in the articular ends during abscess of the joints), forms merely a worm-eaten surface of no particular shape, and extending to an indefinite distance superficially, but affecting little of the substance of the bone. In strumous ulceration the whole of the bone is softened, light, oily, and enlarged, while the surface is worn away by a ragged, irregular ulceration, usually deep in places and extending indefinitely. The main characteristic of rheumatic ulceration is the stalactitic or foliaceous deposit on the surface of the bone, co-existing with sclerosis of its superficial portion, and this deposit penetrated by irregular ulceration, but to no great extent. In malignant ulceration the bone is removed in an irregular manner and to any extent, sometimes almost entirely; but what characterises it unmistakably is the deposit of cancer in the neighbouring bone and soft parts. In the macerated bone these extensive and irregular cancerous erosions are recognisable from the forms of ulcer above described; but they can hardly be distinguished from the rodent or lupoid

[1] 'Diseases of the Bones,' p. 50.

[2] The reader will find in my essay on 'Diseases of the Bones,' already referred to, characteristic illustrations of these and the other recognised varieties of ulcer in bone, for which I cannot here find space.

ulceration, to which bones are also liable, except in the fresh state by the cancerous deposit—usually epithelial—to be found around the ulcerated spot.

I think it unnecessary to add anything here on the subject of the treatment of syphilis in bone to what has been said (pages 388–393) on the general subject of constitutional syphilis. Nor need I speak further about the rheumatic and gouty affections of bone. So far as they come within the province of the surgeon they will be treated in the next chapter, since they are found chiefly in the articular ends of the bones. The subject of lesions of the osseous system in infancy has been treated on page 394.

Cancer in bone.

The soft or encephaloid form of cancer is that which is generally met with in bone, especially as a primary affection; the scirrhous, melanotic, and epithelial forms when they affect bones do so almost always either as secondary formations or by extension from the soft parts.

Osteoid cancer.

Primary cancer in the bones sometimes affects the osteoid form, and in such cases reproduces itself in the same form in the glands and lungs; and it does even happen, in very rare cases, that osteoid cancer occurs as a primary disease in the soft parts;[1] but for practical purposes osteoid cancer may be regarded as one affecting the bones only, and as being a sub-variety of encephaloid. Many malignant tumours of bone have a base of ill-formed hard bone, but it is only to those in which the bony mass seems diffused throughout the cancer, and especially to those in which it is deposited in the glands, that the name of osteoid cancer is appropriate.

Soft cancer.

The common kind of cancer of bones is seen in three different forms — periosteal, interstitial, and infiltrated. The latter is very rare. The whole bone is replaced by a mass of cancer in which, possibly, a few granular portions of the original bone may be formed. This constitutes one form of mollities ossium, for the bone can now be bent in any direction; but it is too rare an event, and the diagnosis is too obscure, to render it worth while to spend further time on it here.



FIG. 202. A section of a malignant tumour, springing from the periosteum of the humerus, and infiltrating the muscles and parts in the neighbourhood. The bone appears unaffected. The arm was removed at the shoulder-joint.—St. George's Hospital Museum, Ser. ii. No. 225.

The interstitial form of cancer is that in which a nodular mass of cancerous material is deposited in the cancellous tissue, which, as it grows, infiltrates and expands the periosteum, and finally bursts out into the soft tissues until it reaches the skin, which is then rapidly disintegrated and gives way, allowing the cancer to fungate through it.

The cancellous tissue is sometimes extensively eroded by these cancerous deposits, which, after maceration, leave irregular worm-eaten cavities in the dry bone.

In the periosteal form, on the other hand, the bone may be perfectly sound,

[1] Paget, 'Surg. Path.' vol. ii. p. 406. ed. 1853.

the tumour having grown wholly outwards, as in Figs. 202–3. But it is practically impossible in most cases to distinguish one of these forms from the other; nor is it of much importance, since both require amputation. The only important matter is to diagnose a malignant tumour from an abscess and from an innocent tumour. The former is by no means easy, for an abscess in connection with the bone is at first tightly bound down by the periosteum and other parts, so that its fluctuation is not very marked; and a malignant tumour is often so soft that it is very doubtful whether to call the sensation fluctuation or no. Any small soft swelling appearing near the head of the tibia is to be looked upon with suspicion, as this is a very favourite seat of malignant disease; and in case the ordinary symptoms of abscess are absent, viz. inflammatory œdema of the skin, pain, and pointing of matter, no confident opinion should be expressed before exploration with a grooved needle.[1]

Diagnosis.

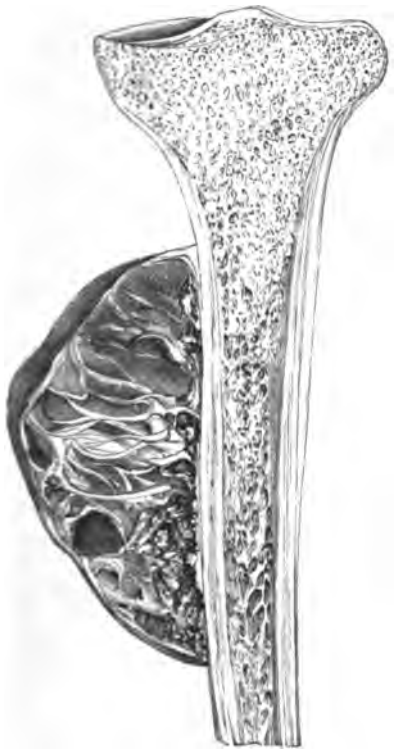


Fig. 203. Periosteal cancer of the tibia. The cancer is a mixture of the hæmatoid and medullary varieties.[2] The chief deposit exists between the periosteum and the bone, the surface of which has been slightly destroyed. Corresponding to the situation of the tumour, the cancellous tissue and medullary canal were, however, infiltrated to a very slight extent.—St. George's Hospital Museum, Ser. II. No. 244.

The diagnosis between cancerous and innocent or semi-innocent tumours is very difficult, and is, perhaps, we may say, becoming more difficult, as the distinction between malignant and innocent tumours is seen to be less marked than used to be taught. Nor ought a surgeon to hesitate in saying that he does not know whether to call a tumour before removal cancerous or sarcomatous. Practically the question resolves itself into the necessity for amputation, and into the prognosis which must be given of the case afterwards. Now, I think we shall not be wrong in saying that a tumour of bone is to be regarded as malignant, and amputation is to be pressed upon the patient as being necessary, whenever the tumour is large, soft, growing rapidly, covered with large veins (which, indeed, are only an evidence of its rapid growth and the consequent profuse blood-supply with obstructed return), and involves a considerable surface of

[1] I have seen even this exploration mislead. A very skilful surgeon, believing that a swelling near the os calcis was an abscess, but not being sure, made a puncture with a grooved needle. A few drops of pus, or a fluid which was taken for pus, escaped. A small incision was made. This gave rise to such copious hæmorrhage that it was believed the posterior tibial artery had been wounded. Accordingly the patient was brought under the influence of chloroform and the part freely laid open, when the supposed abscess turned out to be a malignant tumour, and it became necessary to amputate the foot.

[2] I quote the old description. In the present day it would probably be designated 'an alveolar, hæmatoid, round-celled sarcoma.'

the bone. But there are other considerations also which ought not to be laid out of sight, and which Sir J. Paget has thus expressed ('Med.-Chir. Trans.' liv. 260):—

'1. The tumour is probably cancerous if its growth commenced before puberty or after middle age, unless it be a cartilaginous or bony tumour on a finger or toe, or near an articulation.

'2. If a tumour has existed on or in a bone for two or more years, and is still of doubtful nature, it is probably not cancerous or recurrent, and this probability increases with the increasing duration of the tumour.

'3. If a tumour on or in a bone has doubled or more than doubled its size in six months, and is not inflamed, it is probably cancerous or recurrent; and this probability is increased if, among the usual coincidences of rapid growth, the veins over the tumour have much enlarged, or the tumour has protruded far through ulcerated openings and bleeds and profusely discharges ichor.

'4. If with any such tumour, not being inflamed, the lymph-glands near it are enlarged, it is probably cancerous, and still more probably if the patient have lost weight and strength to amounts more than proportionate to the damage of health by pain, or fever, or other accident of the tumour.

'5. A tumour on the shaft of any bone but a phalanx is rarely innocent, and so are any but cartilaginous outgrowths on the pelvis, or any but the hard bony tumours on the bones of the skull.'



FIG. 204. A section of the skin and of the shaft of the tibia in a case of epithelial cancer for which the leg was amputated. The skin is seen to present a large ulcerated space, which is continued downwards into a cavity hollowed out in the shaft of the bone. The cavity is of large size, irregular in form, and lined by a thick layer of firm substance, which is continuous with the ulcer on the surface of the skin. The bone is much thickened around the diseased part, and its medullary canal obliterated for some distance. The ulcer on the surface, the firm lining of the cavity in the shaft of the bone, and the soft matter infiltrated in the cancelli above that part, consist entirely of scaly epithelium packed together by a fine granular substance. The patient was a man aged 64, and the disease was referred to a blow received two years previously, six months after which a tumour formed in the part struck and rapidly sprouted out of the skin. This tumour had been removed three times by the knife, and a fourth time by caustic, along with a scale of bone, before the limb was amputated. He recovered from the amputation, but the subsequent progress of the case is not known. — St. George's Hospital Museum, ser. ii. No. 238.

If a tumour in bone be diagnosed as being cancerous, and there is no evidence of cancer in other parts, nor of cancerous cachexia, its removal is plainly indicated. It is safer to amputate the member, if possible, above the affected bone; thus, in cancer of the tibia amputation should be performed through the thigh, and in cancer of the femur some surgeons dwell much on the importance of removing the whole femur by amputation at the hip. But the immediate danger of amputation at the hip is very great, and the immunity which it gives from the return of the disease is certainly not proved to be greater than in amputation through the continuity of the femur. I have seen several cases in which the cancer recurred in the lungs very shortly after recovery from amputation at the hip. On the other hand, I am now watching a case where a young man has remained free from any recurrence for more than ten years after amputation through the middle of the femur, though the disease was well-marked soft cancer with pulsation. Much more promising as far as prognosis goes are those cases of epithelioma of the soft parts spreading down into the bone, which furnish the only examples

which I have met with of epithelial cancer of bone. The tibia is the usual seat of the affection (Fig. 204). It is essentially chronic in its course, and it is often a very long time before the bone is affected. Fig. 168 on p. 351 was taken from a patient of mine with cylindroma of the scalp (very probably only a form of epithelioma), which originated in a wound received in the Crimean War, and was confined to the scalp, without affecting the skull, for more than twenty years. And when the bone is affected repeated partial removals may be practised (as in the case referred to in Fig. 204) without causing the evil results which in other forms of cancer such inadequate operations entail. But it is, no doubt, much better to amputate far away from the disease; and if this is done before the glands are affected the patient has a fair chance of remaining free from a return of the tumour for a long time.

Myeloid and sarcomatous tumours.

Many of the tumours which in former days would have been unhesitatingly described as cancerous are now regarded as sarcoma, especially that form of sarcoma described on page 349 as myeloid or 'giant-celled' sarcoma. In fact, many modern pathologists teach that the tumours formerly described as 'cancer' of the bones are always sarcomatous, and that true carcinoma never affects the bones. The distinctive characters of myeloid and other sarcomatous tumours from carcinoma are to be found in their slower rate of growth, in their not affecting the parts around, in their lower vascularity, and in the freedom from contamination of the glands. After removal a myeloid tumour will be found to be more circumscribed, growing from a single centre (while cancer is frequently deposited in several independent nodules), and much less prone to break down and to ulcerate. The microscope will complete the diagnosis. But I cannot help repeating that I find it impossible to accept the doctrines of modern pathologists on this subject of sarcomatous tumours. The so-called round-celled sarcoma is very often of a cancerous nature—if we mean by cancer a tumour which grows rapidly, invades neighbouring structures, infects the lymphatic system, and is prone to recur in the viscera and other distant parts —and so are other forms of sarcoma, though I believe less frequently. The presence of osseous or cartilaginous formations in such tumours seems to be a mark of more decided malignancy.

Innocent tumours of bones. Enchondroma.

The innocent tumours of bone are cartilaginous (enchondroma), bony (exostosis), fibrous (fibrocystic), and cystic. Cartilaginous tumours, or enchondromata, have been spoken of above (p. 841), in their general aspect as they occur in other parts. They are, however, more common in the bones than in any other part, and they grow slowly and often to a very large size,[1] displacing all the structures of the part, but not infiltrating them, and showing no tendency to recur when completely removed. They are either multiple or solitary, they either do or do not ossify, and they occur either in the diffused or the circumscribed form. It is the solitary and the circumscribed enchondromata which show the greatest tendency to ossification; the diffused and multiple enchondromata, such as are seen tolerably often on the phalanges (Fig. 205), show little or no tendency to the formation of bone, though in the process of time they degenerate into a low, calcareous, or fibrocalcareous formation, in which cysts are often found. Such enchondromata in the hand sometimes reach an

[1] In Mr. Gamgee's case a cartilaginous tumour growing from the femur had attained so large a size that the limb after amputation at the hip-joint weighed 99 lbs. See Mr. Gamgee's 'History of a Successful Case of Amputation at the Hip-joint,' 1865, where similar cases of large enchondroma are referred to under the care of Mr. Frogley and Sir P. Crampton.

enormous size. Dr. Martyn[1] has recorded one in which the weight of the hands became so great that the patient could not lift them, and in which the feet were simultaneously affected, but this is unusual. No treatment can be proposed in such cases except amputation, which is necessary when the hand or foot has become entirely useless. The tarsus would be left in the case of the foot, or a portion of it, if the extent of the disease prevented the formation of a flap entirely in front of the tarsus.



FIG. 205. Enchondromata of the fingers and hand, from a cast in the Museum of St. George's Hospital. The patient was a lad about 15 years of age. There is a large tumour on the thumb, and a swelling of the end of the radius, due probably to the same cause.

Cysts are also often found in enchondromatous tumours which show no trace of degeneration.[2] The structure of enchondroma is usually that of pure hyaline cartilage, indistinguishable from the normal tissue.

The diagnosis of enchondromata depends on their hard, lobulated surface (sometimes, however, with a certain amount of elasticity, if the cartilaginous tissue is soft or if there is a cyst in the interior of the tumour), their slow growth, and the absence of all other symptoms. When they grow (as they often do) from the interior of a bone, the shell of the bone may be expanded over the surface, and may be felt to yield with a crepitating sensation. Generally there is little difficulty about the diagnosis, for the symptoms are usually quite different from those of cancer, there is not the hardness of exostosis, and the other innocent tumours of bone are very rare.

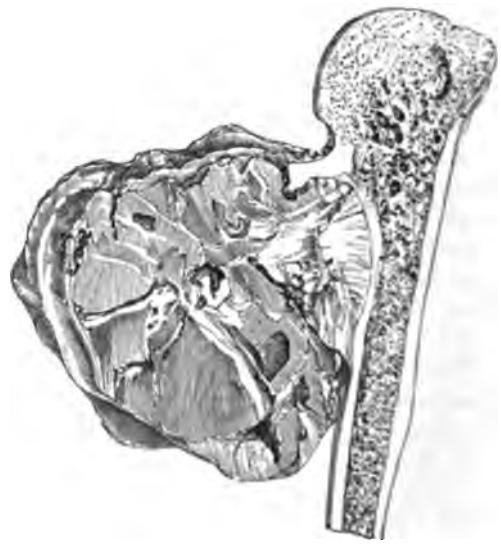


FIG. 206. A cartilaginous tumour of the humerus, of two years' growth, springing from the compact tissue, and encroaching on the cancellous structure. It was removed by amputation at the shoulder-joint, and the patient was seen quite well two years afterwards. On microscopic examination the tumour was found to consist of large oval cells, with one or two nuclei, the wall of many being indistinct. These were closely packed in a finely granular matrix, which in some parts was dimly fibrillated.—St. George's Hospital Museum, Ser. ii. No. 176A.

The treatment must be by amputation or enucleation. The former is required in cases of multiple enchondromata, when any treatment is indicated, in very large tumours, and generally when the operation for removal of the tumour would leave the member useless. Sir J. Paget[3] has shown how much better the prospects of recovery by enucleation are than used to be believed; and since the publication of his paper amputation will be less frequently resorted to, at any rate without preliminary

[1] 'Path. Trans.' vol. xxii. p. 252.

[2] See a beautiful preparation in the Museum of the College of Surgeons, No. 203A, which is, I believe, Mr. Frogley's preparation, described and figured in the 'Med.-Chir. Trans.' vol. xxvi.; and in 'Syst. of Surgery,' 3rd ed. vol. ii. p. 322.

[3] 'Med.-Chir. Trans.' vol. liv. cases 1 to 3, pp. 254–5.

incision, in order to ascertain the nature of the tumour. If the whole bone is involved in the tumour it may be resected to the required extent, and this operation is especially indicated in the upper extremity. Two interesting cases by Mr. Lucas and Mr. Morris will be found in the tenth volume of the 'Clinical Society's Transactions.' In the latter a considerable portion of both bones of the forearm was removed, but the patient recovered with a useful hand. It is in such explanatory operations that the 'bloodless method' recommended by Professor Esmarch (see the chapter on OPERATIVE SURGERY) finds one of its most striking uses. Under the elastic bandage, properly applied, the tissue and the relations of the tumour can be studied on the living subject almost as easily as on the dead, and any vessels, nerves, or other important structures as easily dissected off the tumour. Such operations, however, will occasionally terminate in amputation, a contingency which must be provided for before commencing. I would refer to Fig. 206, which shows a very large enchondroma springing from the humerus outside the shoulder-joint. At the period of the operation the large size of the growth left the operator no choice; but at an earlier stage of the disease it would have been a perfectly justifiable proceeding to have attempted the removal of the tumour alone, preserving the arm. Yet the operator might easily have been baffled in the attempt by finding the great vessels and nerves so buried in the mass that he could not hope for any usefulness in the member after the operation, and would find himself compelled to resort to amputation.

Exostosis.

Exotosis, or bony tumour springing from a bone, is a comparatively common affection in some parts of the body, and occurs under three chief forms. The first is the *ivory* or *hard* exostosis, which is composed of bone resembling the compact shell of the long bones or the external table of the skull, from which it often springs, but is even more compact, so that it exactly resembles ivory, no pores or bone-fibres being visible in its section. On microscopic examination these ivory exostoses show the lacunæ and the vascular canals of true bone, but the lacunæ are more irregularly distributed, and the vascular canals are more numerous and smaller than the Haversian canals.[1]



FIG. 207. Ivory exostosis of the lower jaw. There is no history, but the preparation has evidently been taken from the body of a very old person.– St. George's Hospital Museum, Ser. ii. No. 191.

This form of exostosis is met with only in connection with the bones of the skull and face, and especially on the vertex of the skull and on the lower jaw (Fig. 207). It never attains a large size except when it grows into one of the cavities—the orbit or the antrum. Its growth is very slow, and as a general rule such tumours

[1] See 'Path. Trans.,' vol. xvii. plate 13, for drawings and description of the microscopic examination of Dr. Duka's case of ivory exostosis, figured below.

are best left alone. Their removal is often extremely difficult, in consequence of their great hardness; and the violence which is necessary for this purpose involves very great danger; while the tumour can lead to no ill consequences, apart from the trifling deformity which it causes. But to this rule an exception must certainly be made in the case of ivory exostosis of the orbit. The gradual growth of such a tumour displaces the eye, causing blindness by the stretching of the optic nerve, and a very hideous squint. The base (which is usually attached to the inner or outer angle of the roof



A B

FIG. 208. A shows the general appearance and B the appearance on section of the bony tumour removed from the antrum by Dr. Duka, the account of which is to be found in the 'Path. Trans.' vol. xvii. p. 256. The position of the tumour during life was the reverse of that here shown.—St. George's Hospital Museum, Ser. ii. No. 191A.

of the orbit) is often of no large size, and when fully exposed can be partially cut through with a fine saw, and then broken with a few blows of a chisel and hammer. If the operation have not been too long delayed, the eye will return into position and sight will be restored. It is well not to go too near to the skull in making the section, though this must of course depend on the shape of the tumour's neck. Again, an exception may be made in ivory exostosis of the antrum. These exostoses often have very small bases, and are found to have undergone fracture at their neck and to be lying loose in the antrum. Such was the case in the instance which furnished the preparation represented in Fig. 208, and which occurred in a native of India, a patient of Dr. Duka.[1] On removing the front wall of the lower jaw the large mass of ivory-like bone here figured was found lying quite loose, its attachments having been separated either by the weight of the mass or by some accidental violence.



FIG. 209. Ivory exostosis, which was trephined, unsuccessfully, on account of its great hardness. Exfoliation was afterwards produced by the long-continued application of caustics, chiefly nitric acid. St. George's Hospital Museum, Ser. ii. No. 189.—From 'Syst. of Surg.' 3rd ed. vol. ii. p. 325.

It may be mentioned, as some encouragement to the attempt to remove such tumours when it is otherwise indicated, that the tumour often has a much smaller neck than its size would lead one to expect, and also that the interior may be cancellous, while the exterior appears perfectly ivory-like. Such was the case in a remarkable tumour of the skull described and figured by Mr. Ilott.[2] The patient had consulted many eminent surgeons, but all had shrunk from the apparent danger of removing it, believing that the neck was of great breadth, and of ivory-like consistence. On the contrary, when the patient died it was found that the tumour was of a mushroom-shape, the

[1] 'Path. Soc. Trans.' vol. xvii.

[2] 'Path. Soc. Trans.' vol. iii. p. 149.

neck comparatively small, and the interior of the tumour wholly cancellous. The tumour might, therefore, probably have been removed with safety. On the other hand, many histories show the risks that may be encountered in such attempts. There are in St. George's Hospital Museum two preparations, one (Fig. 209) showing a small bony tumour with the marks of a trephine with which and other instruments Mr. Keate strove in vain for more that an hour to take away the little lump, but was obliged to desist. The patient obstinately refused to submit to the slight deformity, and was ultimately rewarded for his perseverance by its removal. Repeated applications of strong nitric acid and potassa fusa at intervals during several years produced its exfoliation, but at an expense of pain and danger quite disproportionate to the result. In the other case, Sir A. Cooper had tried to saw off a small ivory exostosis from the margin of the orbit, but in vain. This also exfoliated after repeated applications of caustic, and the marks of the saw are still to be seen upon the little tumour.



FIG. 210. A small exostosis of the femur, situated just above the internal condyle. The neck of the tumour, shown at the upper part of the woodcut, as well as a large part of the growth continuous with this, is composed of firm cancellated bone; the rest of opaque white cartilage, composed of large cells, of an oval or circular form, closely approximated. The surface of the tumour is covered by a thin incrustation of fibro-cartilage.—St. George's Hospital Museum, Ser. ii. No. 178.

The soft or cancellous exostosis (Fig. 210) is a much more manageable disease, and operations for its removal are, at any rate under certain circumstances, justifiable. It grows either as an outgrowth, consisting primarily of bone, or as the result of the ossification of a cartilaginous tumour. In the latter case the internal tumour, composed of cancellous bone, is surrounded and encased by a layer of cartilage. The favourite seats of exostosis are in the neighbourhood of the epiphyses, particularly those of the femur and humerus, and on the extremity of the last phalanx of the great toe; but they occur in all parts of the body. They should only be removed in consequence of some symptom caused by their presence greater than the risk of removing them would be, for there is no doubt that, as a rule, if not always, their tendency is to stop growing. Hence on the great toe, where the little tumour causes serious inconvenience in walking, and it can be removed with hardly any danger, this should always be done; but when the exostosis is deeply seated (as in the very common instance of that which grows just above the internal condyle of the femur) and is near important structures,[1] it is very doubtful



FIG. 211. Exostosis of the finger springing from the base of the first phalanx, in a man aged 58. The bone is seen to be healthy. The whole tumour is completely ossified into spongy bone, with the exception of a very thin layer of cartilage which covers its surface (on the unshaded portion of the diagram).—St. George's Hospital Museum, Ser. ii. No. 181.

[1] The knee-joint has often been opened in removing this exostosis, for in such cases previous attacks of inflammation may have enlarged the synovial membrane beyond its natural limits.

whether the patient is well-advised in incurring any great risk in order to avoid inconveniences which after all are often trifling, and which may be trusted not to increase. If the surgeon have made up his mind to operate he may be certain that the removal of the surface and the greater part of the neck of the tumour will perfectly suffice to stop the disease; no renewed growth need be apprehended. In the cartilaginous exostosis all the ossifying material is removed in such an operation, and in the bony outgrowth the remains of the neck never, as far as I know, are the origin of any renewed growth.

It has often been noticed that exostoses sometimes suffer fracture, and a remarkable case has been published[1] in which an exostosis of the femur, having been thus broken off from the bone, became entirely absorbed, so that a tumour which seemed at first to be of the size and shape of a walnut left no trace whatever of its existence; and Mr. Maunder, I believe, treated several cases by fracturing or dividing subcutaneously the neck of the exostosis. The treatment is eminently worthy of trial, though in the



FIG. 212. A diffused bony tumour of the lower jaw (diffused exostosis), removed with success at St. George's Hospital, by Mr. Tatum. *a* shows the articular surface of the jaw; *b*, the symphysis. The operation consisted in the removal of the whole of that side of the bone. 'Path. Soc. Trans.' vol. ii. p. 95. St. George's Hospital Museum, Ser. ii. No. 185.

only three instances I have seen, under the care of Mr. Pick and myself, it was not successful. If the exostosis is not absorbed after the fracture of its neck, and its presence gives the patient inconvenience, it might be removed when loose with far less danger than is involved in cutting through its base. Fig. 211 will illustrate the feasibility of this method of treatment. A tumour so large as this relatively to its neck could easily be divided from its attachment, either by fracture or by subcutaneous section with a chisel or fine saw, and passive motion might prevent any tendency to reunite.

The diffused bony tumour is illustrated by the accompanying figure (Fig. 212), showing a large lobulated mass of bone enveloping the jaw for a considerable distance, and only removable by extirpation of the whole of the bone from which it grows. Another and a very singular case is illustrated by a series of three preparations in the Museum of the College of Surgeons, in which, after amputation on account of such a tumour, situated near the knee, the tumour recurred in the stump five years afterwards; re-amputation was performed, and then the disease again recurred in the pelvis. The tumour could not have

[1] Dr. Chiene, 'Ed. Med. Journ.' July 1874.

been malignant, for the duration of the affection was no less than twenty-five years, and the patient died only of the local consequences of the pressure of the tumour.[1] Other similar cases have been noticed, and they bear a remarkable analogy to those of the recurrent fibroid tumour of soft parts.

Innocent soft solid tumours.

The other innocent solid tumours are rare, if we except epulis and fibrous or nasopharyngeal polypus, which are treated of in other chapters. They generally grow from the periosteum, and are of the fibrous, 'fibrocellular,' or fibrocystic variety. Very commonly they are mistaken for enchondroma before operation; and as the treatment and the prognosis are the same, the mistake is of no importance, nor can I lay down any trustworthy rules for the diagnosis. The majority of such tumours seem to be connected with the femur.[2]

Hydatid and other cysts of bone.

Cystic tumours of bone are serous and sanguineous. The former, if they are not confined to the jaws (as Mr. Stanley believed them to be), are at any rate only known in that situation, and these are in all probability always caused by some irritation around the teeth-cavities. They form sometimes enormous tumours in the jawbones (usually the lower), with the wall formed in some parts by thin crepitating bone, in others by fibrous tissue, and containing clear fluid. The diagnosis is easily made by puncture.

In other bones the presence of hydatids has given rise to the formation of cavities containing a thin fluid, but whether independently of hydatids serous cysts form in other bones seems doubtful.

Both forms require similar treatment, viz. to be laid open pretty freely, when if hydatids are found they are to be evacuated, otherwise the opening is to be kept free and the cyst left to fill up gradually. In a case which furnished a preparation to the Museum of St. George's Hospital, Sir B. Brodie removed the whole side of the lower jaw, on account of an unusually large cyst of this nature, but the operation proved fatal from erysipelas. I never saw one of so large a size, but have seen a few smaller ones which have done well under the simpler treatment.

The blood-cysts in bone are still rarer, and many of the cases were clearly only instances of malignant or myeloid (sarcomatous) tumours with blood-cysts of very large proportionate size formed in them. I must refer the reader to the authorities named below[3] for illustrative cases. The treatment would generally consist in laying open and stuffing the cyst if no tumour-formation could be detected in the walls, otherwise in excision or amputation.

Pulsating tumours of bone.

One remarkable feature of tumours of bone is pulsation. This symptom when seen is usually taken as a proof that the tumour is cancerous. It has, however, been noticed undeniably in myeloid tumours, and in others, as to which no evidence existed of malignancy: nay, in some where the course of the disease afterwards showed that it could not have been cancerous. Some of the latter, in which nothing but vascular tissue was discovered, are regarded as being examples of the disease described by Breschet, under the name of

[1] See 'Syst. of Surg.' 3rd ed. vol. ii. p. 327.

[2] See Adams and Hewett, in 'Path. Trans.' vol. v. p. 254.

[3] Travers, 'Med.-Chir. Trans.' vol. xxi. Stanley, 'Dis. of the Bones,' p. 187. Liston, so-called 'Ossified Aneurism of the Subclavian Artery,' 'Ed. Med. and Surg. Journ.' vol. xvi. pp. 66, 215. Nélaton, 'Path. Chir.' vol. ii. p. 48.

Osteo-aneurism.

aneurism of the bones (osteo-aneurism), and which he believed to be formed entirely of dilated bony capillaries, just like the aneurism by anastomosis of soft parts. When a tumour of bone pulsates it will most commonly be found to be a cancer in which there is a space or more commonly several spaces communicating with the arteries which supply the tumour, and large enough to give rise to pulsation perceptible to the eye and the hand. The pulsation is also sometimes, though more rarely, perceptible to the ear, and thus the symptoms resemble those of aneurism so very nearly, that when the tumour grows in the neighbourhood of some large artery, as in the abdomen, near the course of the aorta or iliac arteries, in the buttock, near the gluteal, or in the femur, near the popliteal or femoral artery, the mistake has been committed by the most eminent surgeons, even after deliberate and repeated consultation, and that in both ways, i.e. aneurism has been mistaken for malignant tumour, as well as the reverse. I think this is sufficient evidence that in the present state of surgery the mistake is in some cases inevitable.[1] The main points of distinction between the two diseases are the following: Aneurisms usually have a distinct and loud bruit, pulsatile tumours none at all, or an indistinct one. Aneurisms have an expansive lateral pulsation (as well as the up-and-down pulsation), and this is not usually the case in pulsatile tumours. Aneurism does not affect the bone unless it has eroded or absorbed it (which is rare in the limbs); pulsatile tumour is very commonly accompanied by some expansion of the bone on which it grows. Aneurism can usually be moved to some extent on the subjacent bone; pulsatile tumours are hardly known except as springing from bones, and therefore incorporated with them. Aneurisms are often of longer duration than pulsatile tumours attain without fungating or destroying the patient's general health.

It is by a careful consideration of all these symptoms that the diagnosis must be made; and in any case of doubt it seems the surgeon's clear duty to give the patient the benefit of it, and to select the milder operation of ligature of the main artery in preference to amputation, especially considering that if the tumour do turn out to be malignant even the latter operation would probably only give a brief respite.

If the case is evidently one of pulsatile tumour of a bone, amputation is, as a general rule, to be advised when possible; but there are pulsating tumours which can be eradicated with success, as is proved by the cases related by Sir J. Paget ('Med.-Chir. Trans.' vol. liv. pp. 256–7), in one of which the tumour turned out to be of a fibrous nature, and the patient was known to have remained in good health ten years after its enucleation. In one other case a tumour, believed to be merely an aneurism of the bone, was successfully enucleated by means of the actual cautery.[2]

Such cases do undoubtedly justify the surgeon in proposing the removal of the tumour only, when the latter is growing very slowly, so as to be evidently not cancerous, and especially if there be so little evidence of solid tissue around the vascular mass that it may be hoped that it is a mere aneurism of the bone. In any such case, however, the patient should be prepared for amputation if necessary.

[1] Cases of erroneous diagnosis have been published in the case of abdominal tumour under Sir J. Paget's care, of gluteal under Mr. Guthrie's, of popliteal under Mr. Pollock's; and are referred to in a paper of mine, 'On the Diagnosis of Aneurism,' in the 7th vol. of the 'St. George's Hospital Reports.'

[2] Mapother, 'Dublin Med. Press,' Feb. 4, 1863. In a case where Mr. Bickersteth amputated the leg for pulsating tumour of the tibia, the disease on examination was believed to be a pure example of osteo-aneurism, and no return took place.—See 'Syst. of Surg.' 3rd ed. vol. ii. p. 320.

A very singular and rare affection in bones is known by the name of Mollities Ossium, Osteomalacia or Malacosteon. There is no doubt that under this designation several morbid conditions have been described, most of which constitute separate diseases, and have been noticed above. Thus bones become softened by the diffused form of infiltrating cancer (see p. 432).[1] Again, bones have been known to be so softened by inflammation in the course of constitutional syphilis as to be described by the name of Mollities.[2] And cases of spontaneous fracture from cancerous deposit or from other causes have been incorrectly enough spoken of as Mollities. But the peculiar disease which is properly so designated is marked by the gradual softening, bending, and very probably the ultimate fracture of the bones, usually of several parts of the body, or at any rate of a great extent of bone, while the patient is not in any visible condition of disease, except for the weakness and the loss of function which the softening of the skeleton produces. Mollities is, therefore, distinguished from cancer by the fact that in the one numerous and extensive tracts of bone gradually soften, bend, and perhaps ultimately break, while the deposit in cancer generally occurs at one definite spot, and the bone yields there abruptly, besides which there is often no fatal cachexia in mollities; in fact, in many cases the patient has died of old age. From rickets, to which it is compared by some authors, who speak of it as 'senile rickets,' mollities is distinguished by the essential feature that it has no tendency to recovery, while rickets always disappears if the child survives. Mollities ossium.

The symptoms of true mollities are very striking. The disease generally commences with pain mistaken for rheumatism, and sometimes this pain lasts long and is very severe. A great part of the skeleton, sometimes the whole pelvis or thorax, or many of the bones of the limbs, become so soft and weak that they bend under the ordinary muscular actions; till sometimes (as in the often quoted case of Madame Supiot) the feet can be placed above the head, and the patient is quite bedridden from the weakness of the body; and the stature may even be much diminished from the falling together of the vertebræ. Fracture is very common, but curiously enough the bones may unite again. Dr. Ormerod published a case[3] in which there were a great number of fractures—at one time seven different bones were fractured—and yet the fractures united just as readily as they do in rickets. Often, however, the fractures show no tendency to unite. Most of the patients are past the middle period of life,[4] and are of the female sex, though men also suffer from the disease.[5] It is said that the bones of lunatics are more fragile than those of the sane—and one case at any rate of genuine mollities in a lunatic is on record;[6] but exact details are wanting. Persons affected with this disease usually die from mere decay of nature—sometimes from intercurrent disorders, as pneumonia—sometimes from deficient respiration, in consequence of the loss of mobility of the softened chest-walls, or from pressure on the spinal cord or medulla.

[1] A good example of this is in the Museum of St. George's Hospital, showing two vertebræ completely softened by cancer, which has entirely replaced their natural structure.

[2] The existence, however, of any softening of bones in syphilis so diffused as to deserve the name of osteomalacia is doubted by Lancereaux, 'Treatise on Syphilis,' trans. for 'New Syd. Soc.' vol. i. p. 243.

[3] 'Brit. Med. Journ.' Sept. 10, 1859.

[4] One hitherto unique case was exhibited to the International Med. Congress in the skeleton of a child under two years of age. See their 'Trans.' Dis. of Children, p. 59.

[5] Out of 145 cases which Mr. Durham refers to, 13 only were men; but then in a great number of these, which are recorded only for obstetric purposes, the true nature of the disease is very doubtful.

[6] Dr. Atkins, 'Brit. Med. Journ.' June 26, 1880.

The pathological anatomy of the softened bones bears a considerable resemblance to rickets, and also to fatty degeneration. In some cases the fatty degeneration has been so extreme that the bone resembled 'rather a portion of fatty matter enclosed in a case of periosteum than a bone.'—(Ormerod.) At other times the outer shell has been healthy, while the central cancellous tissue has been softened. The cancelli will be found enlarged, sometimes to such an extent that the whole bone is expanded and filled with a peculiar reddish gelatiniform matter, in which fat, oil, and blood-discs will be found, together with certain cellular bodies, according to Dalrymple.[1]

Rindfleisch thus describes the microscopical appearances of bone in mollities: 'If we break off a minute trabecula from the cancellous texture of a bone affected with this disease, and after soaking it in carmine examine it under a magnifying power of 300 diameters, we find a highly characteristic set of appearances (Fig. 213). The trabecula is seen to consist of two different substances; it exhibits two very distinct zones—an outer one, lying next

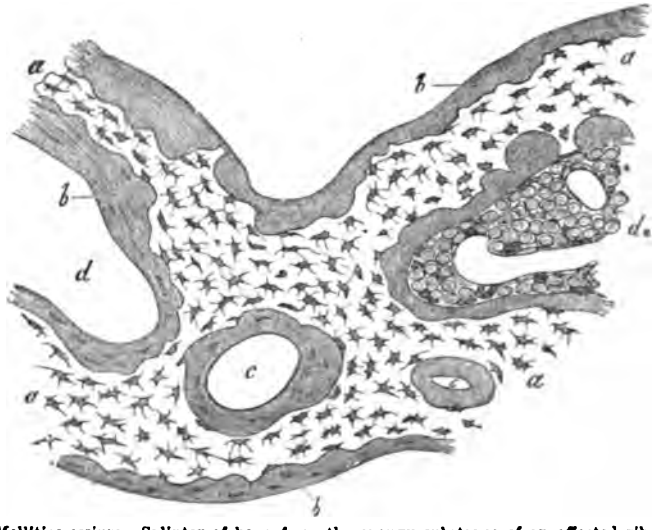


FIG. 213. Mollities ossium. Splinter of bone from the spongy substance of an affected rib. *a*. Normal bone-tissue; *b*, decalcified bone-tissue; *c*, Haversian canal; *d*, medullary spaces; d_2, a medullary space filled with red marrow. After Rindfleisch.

to the medullary spaces (*d*) and the Haversian canals (*c*), and an inner one, which forms the axis of the trabecula. The inner zone consists of perfectly normal bone-tissue; the corpuscles with their countless anastomosing prolongations, the highly-refracting colourless basis-substance, are unaltered. The outer layer, on the other hand (*b*), exhibits a finely striated basis-substance, deeply stained with carmine, in which only a few scattered streaks of shadow indicate the former position of the bone-corpuscles, while of their processes not a vestige remains; it seems rather as if a swelling of the intercellular substance were engaged in obliterating all the lacunæ together with their canaliculi. The alterations remind us too forcibly of those which the bone-tissue presents when soaked in hydrochloric acid to leave us in doubt for one moment that a process of decalcification is taking place in the present instance.'

[1] 'Dublin Quarterly Journ.' 1846. A very full account of the microscopical and chemical changes found in the bones in mollities is contained in Mr. Durham's paper in the 'Guy's Hospital Reports,' vol. x. 3rd series, 1864.

The nature of the morbid change in mollities is by no means clear. The earthy base of the bone is absorbed, and much of it may be found passing away in the urine, but how or why this occurs we are at present entirely ignorant. That it is somehow associated with a generally depressed condition of the system, caused in some cases by repeated pregnancy, in others by mental suffering, in others by privation of various kinds, seems to be conceded, but nothing is known as to how this cause acts, nor why its effect should be so strikingly marked on the bones, while the rest of the body is unaffected.[1]

A more interesting question is whether the disease is curable, and how to treat it.

Mr. Durham is disposed to answer the former question in the affirmative; and he is able to refer to two cases of alleged cure which rest on the authority of Beylard[2] and Trousseau. And in several other cases, which ultimately proved fatal, a considerable temporary improvement has been noticed under treatment. The treatment must be stimulant and supporting, as far as the digestion will permit; and the use of mineral acids, of course with due reference to the reaction of the urine, phosphates and cod-liver oil, seems to be indicated.

Many cases of deformity of the pelvis leading to difficulty in parturition are described in summary terms as 'mollities,' but the great majority of them have undoubtedly been instances, not of the disease here described, but of old rickets, though some have probably been cases of true mollities.

Rickets.

Rickets is a constitutional disease, nearly allied to struma, the chief manifestations of which are found in the bones, but which implicates other organs, especially the great viscera, a fact which should never be left out of sight in speaking of or treating rickets.[3] But the important peculiarity of the morbid diathesis in rickets is that it is not permanent. If the child survives, the disease will disappear, though the deformities produced by it will remain for life. And rickets is very rarely fatal in itself, although it is pretty often indirectly fatal; i.e. the child is so much weakened as to succumb to some infantile disorder which he would otherwise have thrown off. It may be combined with struma or congenital syphilis.

Rickets may commence, as it is believed, in utero, and is supposed to be one of the causes of intra-uterine fracture, but generally it does not begin till about the time when the child is beginning to walk, and often not till two or three years of age, or even later. Its causes are found in anything which produces weakness: bad feeding, bad air, want of cleanliness—poverty, in fact—are the common causes.[4] Hence Sir W. Jenner says that rickets is the commonest

[1] I think it is a pity to waste space here on mere hypotheses. The reader will find them all stated and discussed in Mr. Durham's paper.

[2] Beylard, 'Du Rachitis, de la Fragilité des Os, de l'Osteomalacie,' pp. 266, 274. In one of these cases the person affected managed by gradual extension to increase her stature by half a mètre—i.e. more that eighteen inches—from what it was at the period of greatest curvature of the spine. The duration of the case extends over about twenty years, and the patient was then in good health, though deformed.

[3] Sir W. Jenner has insisted, perhaps more strongly than any other author, on the constitutional origin of rickets. 'Med. Times and Gazette,' vol. i. 1860. Dr. Dickinson has described the enlargement met with in the liver and spleen chiefly, but also in the lymphatic glands, in rickety children as an increase in the fibrous and epithelial tissues of the organs, producing an appearance much like that of the ordinary lardaceous or so-called 'amyloid' degeneration, but not giving the characteristic reaction with iodine.—'Med.-Chir. Trans.' vol. lii.

[4] A disease believed to be identical with rickets was produced in puppies by improper feeding.—Dick, 'Path. Soc. Trans.' vol. xiv. p. 289. Similar experiments with similar results were made by M. Jules Guérin.

constitutional disease among the children of the poor in London. But the children of the rich are not exempt from it, and in them it shows itself chiefly in the later members of large families, the mothers being exhausted by repeated pregnancies, or in the children of parents suffering from the hereditary taint of struma, or possibly syphilis.[1]

The early symptoms of rickets are not always well-marked. The child appears restless and out of health; if it has begun to walk it will be 'taken off its feet,' as the nurses phrase it; its dentition is probably retarded, the breath fœtid, and the digestion disordered; but these symptoms are not in themselves conclusive. The first distinct indication of rickets is a swelling of the cartilaginous extremities of the long bones, and generally near the wrist or ankle, or of the ribs where they join with the costal cartilages. The child is usually also noticed to be restless and to throw off the bedclothes, and often the head sweats profusely. The fontanelles are often very late in closing, and the head large. Now begins a stage of more or less general softening of the bones—those of the limbs become bent, the curves being generally an exaggeration of the natural curvature of the bone, and due partly to pressure in walking or crawling, partly to the traction of the muscles. Fracture is very common in the stage of softening, the fractures uniting very readily and kindly. In many cases the periosteum is not torn. Sometimes the bone is bent, but not entirely broken. The chest-walls are distorted, the lower ribs being drawn in, somewhat as though a string had been tied round the chest above the liver. This distortion is due in part to the softness of the thoracic parietes, causing them to yield to atmospheric pressure, for there is in these cases, as Sir W. Jenner has shown, a tendency to collapse of the upper part of the lungs, so that the external pressure of the atmosphere is not balanced by the air inside; and the same result may be favoured by attacks of 'child-crowing' or laryngismus stridulus, to which these weakly children are very liable. But the deformity is also due in part to the lower ribs being pushed out by the enlarged liver and spleen. And it may also be partly due to the diaphragm pulling inwards the parts of the ribs to which it is attached. The common 'pigeon breast' may also co-exist with this rickety deformity. The spine is not peculiarly liable to distortion in rickets. When this occurs it may take place in any direction, the most common, perhaps, being 'kyphosis,' or a generally diffused curvature backwards, easily distinguished from the abrupt, limited projection of angular deformity; but 'lordosis,' or the forward displacement of the bodies of the lumbar vertebræ, may be produced by obliquity of the pelvis caused by the deformity of the lower extremities, or lateral curvature by unequal length of the two legs from a bend or fracture of one of them. The pelvis is often grievously deformed, its outlet being narrowed, the tuberosities of the ischia pressed towards each other, and the pubic arch widened, or the pubes pressed backwards towards the sacrovertebral angle, and the ischia thrust outwards.[2]

[1] An attempt has lately been made by M. Parrot to prove that rickets is merely one of the manifestations of constitutional syphilis. I have not space to enter into the discussion here, but cannot refrain from saying how much I dissent from the views of M. Parrot, which seem to me in flat contradiction to every-day experience, and to be founded too exclusively on pathological specimens and theoretical assumptions. The most that seems to me to result from M. Parrot's specimens and arguments is that rickets may exist along with hereditary syphilis, and that very probably a large proportion of syphilitic infants may be rickety. I would refer the reader who wishes to study the subject to the section on Diseases of Children in the 'Trans.' of the International Congress.

[2] I have before observed that many cases related in obstetrical works as instances of mollities were in all probability cases of deformity from rickets.

In other cases the pelvis is simply retarded in development, so as to retain in mature life the small relative size of infancy.[1] This latter condition is connected with an interesting fact noticed by Mr. Shaw, viz. that in cases of old rickets the whole adult body often preserves the proportions natural to infancy —the relatively small size of the face, of the pelvis, and of the lower limbs— irrespective of any deformity in any of these parts.

The chief features of the pathological anatomy of the bones in the active stage of rickets are a large production of growing tissue at the epiphysial ends, a softening of the bony tissue of the shaft, with enlargement of the lacunæ, which are occupied by a red pulpy substance, and a great thickening of the periosteum.

There seems no doubt that the enlargement of the ends of the bones and the softening of their shafts, which are prominent phenomena in rickets, are due to an abnormal excess in the quantity, accompanied by imperfection in the quality, of the ossification. Thus, at the ossifying extremities (epiphysial cartilages) of the bones, the cartilaginous ossification is seen to be excessive in that the ossifying layer of cartilage-cells is very much increased in thickness— many of these proliferating cells are seen to be directly calcified—the embryonic medullary spaces are of very large size—and the basis-substance which separates them is permeated with calcareous salts forming an imperfect areolar or spongy tissue—the interstices of which, as well as the primary areolæ, are filled with a copious medullary (or embryonic) tissue—and according to Cornil and Ranvier the medulla which fills the medullary canal of the shaft itself is often organised into a kind of membrane. So, also, in the subperiosteal or membranous ossification the ossifying layer is much thicker, more adherent to the bone, and forms a mass of spongy cellular substance in which irregular lines of calcification make their appearance, until it is converted into a layer of weak spongy bone much thicker, but also much less solid, than the normal compact tissue, which all this time is being absorbed from its lower surface in the natural process of growth. If the disease is cured without any alteration of the shape of the bone, all this is made good again, the swollen epiphysial ends resume their natural shape, and the spongy exterior is modelled down into the natural compact tissue. But if a bend occurs the spongy wall of the bones is thickened still further in order to strengthen the curved bone, and its subsequent conversion into compact tissue as the disease is cured forms those ridges or buttresses which are so familiar in rickety bones in the place of the linea aspera and other similar situations.[2]

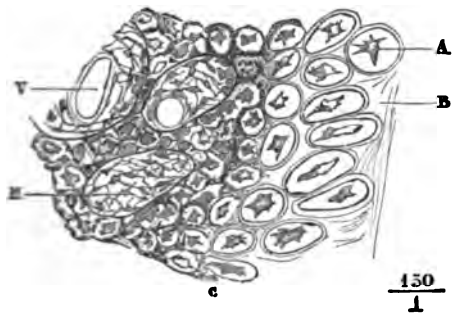


FIG. 214. Rickets. Formation of the spongy bone-tissue from the proliferating cartilage. A. Cartilage-cell shrunk by the reagent. B. Basis-substance segmented. C. Basis-substance impregnated with calcareous granulations. M. Medullary cavity filled with embryonic connective tissue. V. Vessel.—From Cornil and Ranvier.

The effect on the skull is worthy of especial mention. The exuberant and imperfectly ossified tissue causes a great enlargement of the cranial bones, with

[1] See Dr. Little's account of Mr. Shaw's researches on this subject. 'Syst. of Surg.' 3rd ed. vol. iii. p. 820.

[2] I would refer the reader for fuller descriptions to Rindfleisch's 'Path. Histology,' or to the work of Cornil and Ranvier.

disappearance of the distinction between the two tables and the diploe, till the whole skull presents a uniform thick layer of crumbly, porous bone. In the occipital bone, according to Rindfleisch, the pressure of the brain and counter-pressure of the pillow in lying often cause absorption, and so thinning and even perforation of the skull (cranio-tabes), now claimed by some observers as a symptom of congenital syphilis.

To the softening stage succeeds the stage of induration, in which the enlarged and bent bones ossify, and the patient recovers, but too often with permanent deformity from neglect during the early stages of the malady. Growth also in the severer cases is more or less stunted over the whole body.

The treatment of rickets is medical and surgical. The medical treatment is, no doubt, the most important, and if commenced early enough and carried through with care it usually makes all but the simplest surgical measures unnecessary. Great attention should be paid to the diet, to see that it is wholesome and sufficient, to the action of the bowels and skin, and to all other accessible hygienic measures. During the softening stage the child should be carefully nursed, and prevented, as far as possible, from crawling or walking. Cod-liver oil, iodide and phosphate of iron, or other ferruginous tonics, usually procure rapid improvement of the health when combined with proper general treatment. But the misfortune of these cases is that the circumstances of the poor children often prevent them from having proper attention, diet, and regimen, or the ignorance of the parents and the easy assumption that the child 'will grow out of it' prevent them from applying for advice till deformity has far advanced.

The use of splints to the deformed limbs in rickets is not to be heedlessly adopted in deference to routine. It is useless to apply ordinary splints and bandages with a view to straighten the bent bones, except in the period of considerable softening, and then their application demands much care. If the pelvis is softened it is believed that the weight of the splints on the legs will increase the pelvic deformity. However, by careful splinting I have often succeeded in redressing incipient deformity, and have no doubt of the propriety of the practice. Another great benefit in splints is that they may be made to project below the feet, and so effectually prevent the child from walking—a great point with poor children, who have no special nurses.

Knock-knee generally requires a special instrument, which must be carefully adapted to the individual case; and it must be remembered that in inveterate knock-knee it is not alone the ligaments that have yielded, but the shape of the bones is also altered, the internal condyle sometimes projecting below the level of the external, or the shafts of the long bones being changed in shape, so that only an imperfect cure is possible without the section of the deformed bone.

Operations for rickety deformity and knock-knee.

Finally, there are cases in which it may be justifiable to perform osteotomy, subcutaneously or otherwise, and put the leg straight, treating it somewhat like a compound fracture. Mr. Marsh has recorded[1] some interesting and successful cases of this operation, which, however, it will be readily understood, is only occasionally justifiable. The whole subject of osteotomy for rickety deformities and for knock-knee will be treated in the chapter on Orthopædic Surgery.

Hypertrophy.

Hypertrophy of the bones is a result, in many cases, of chronic inflammation or sclerosis; but here the propriety of the term may well be questioned.

[1] 'Med.-Chir. Trans.' vol. lvii. p. 145.

Such cases are instances of chronic ostitis, and ought to be so described.[1] There are other cases in which no inflammatory symptoms are known to have ever been noticed, as in the skull which is preserved in the Museum of the College of Surgeons, enormously thickened, the history of which states that the patient was only made aware of the condition of the skull by finding that the size of his hat was constantly enlarging, though here the disease certainly resulted from injury. It is chiefly in the skull that specimens of hypertrophy are preserved in our museums,[2] and as a rule nothing is known about the patients during life, except that many have been insane or of weak intellect. Some of these skulls are greyish in colour, very porous, irregular in structure —aptly compared by Mr. Durham[3] to dried mortar. Others, however, are much more dense and hard, though, like the former, 'they have a certain rough irregularity of texture.' The former are described under the name of 'osteoporosis.' The latter are regarded by Rokitansky as instances of consecutive induration, succeeding on this osteoporosis. But Mr. Durham is inclined to doubt this and to conjecture that the light spongy bones are examples of arrested mollities (which he regards as a curable affection), and the latter as the result of cured rickets. The idea must be regarded as a conjecture merely at present, but it is an interesting one, and deserves to be elucidated by further researches. Mr. Stanley has pointed out an interesting fact in the cases which he describes as hypertrophy of the long bones, viz. that the affected bone often increases in length.[4] Sometimes the whole limb is lengthened, or when one bone (as the tibia) is affected and the other is not, either the affected bone will be observed to be curved, in order to adapt it to the normal length of the other, or the ligaments uniting the two bones will yield.

Atrophy

Atrophy of bone ('fragilitas ossium') is not so much a disease in itself as a symptom of many other diseases, the chief of which are inflammation, fatty degeneration, ankylosis leading to disuse of the limb, and injury. Senile degeneration is also a frequent cause of atrophy—a fact illustrated by the fracture of the neck of the femur, spoken of on p. 276 (see Fig. 106). Atrophy, strictly speaking, consists in the mere removal of the tissue of the bone, with no alteration in its composition, and it is best illustrated by preparations in which, from ankylosis of the joints, or from prolonged confinement, the limb has become useless, and the bones are found to be light and papery, the compact shell greatly reduced in thickness, and the medullary cavity enormously increased in size by the disappearance of most of the cancellous tissue. Here the bone, if examined microscopically, would appear quite healthy. In practice, however, some amount of fatty degeneration usually accompanies atrophy, especially when due to old age. The rarefying stage of ostitis is a kind of atrophy, and this may be continued as a permanent condition. Such was the celebrated instance quoted by Norris,[5] in which atrophy of the

[1] See Mr. Stanley's cases, op. cit. pp. 2, 3.

[2] Mr. Stanley speaks also of hypertrophy of the facial bones, and especially of the upper jaw. These cases seem to be of the nature of that curious hypertrophy or chronic inflammation named by Virchow 'Leontiasis ossea,' and referred to by Sir J. Paget in his paper on 'Ostitis Deformans' ('Med.-Chir. Trans.' vol. lx.) as to some extent analogous to that disease. Its exact pathology, however, is by no means clear.

[3] 'Guy's Hospital Reports,' 1864, p. 380.

[4] See also Paget, 'Surg. Path.' 3rd ed. p. 62.

[5] 'Amer. Journ. Med. Sci.' Jan. 1842, p. 39. It is to this condition, as far as I can understand, that Billroth has applied the curious name 'ostitis malacissans.' A few other instances of this inflammatory absorption have since been put on record.

humerus followed on fracture twice repeated, and where the whole bone disappeared, leaving the forearm 'swinging hither and thither like a thong,' and the arm shortened six inches. This can only be understood as being the result of chronic ostitis. In other cases atrophy after fracture is believed to depend on laceration or obstruction of the medullary artery of the bone.[1] The suspension of growth which follows on separation of the epiphyses, as well as the cases in which the epiphyses remain ununited, may be classed along with atrophy; and the absorption which follows pressure is, at any rate, closely related to atrophy. Thus it will be seen that as hypertrophy appears to be often only a very chronic stage of ostitis, considered as a productive process (sclerosis), so atrophy bears a similar relation to rarefying ostitis.

No treatment is known to have any effect on either of these pathological processes.

Spontaneous fracture.

Spontaneous fracture is rather a loose term, the fracture being, in fact, always due to some slight force which would be insufficient to fracture a healthy bone. Its common causes are atrophy, malignant disease, mollities, rickets, necrosis (especially in its acute form), caries, and especially strumous deposit in the bone, whether accompanied by suppuration or no. To these causes we must now add, according to the recent researches of M. Charcot, disease of the nervous centres.[2] There are cases spoken of under the name of 'fragilitas ossium,' in which there is a peculiar disposition to fracture, yet without any known atrophy of the bones, and in which the fractures unite in the usual manner; and it seems that the tendency may be hereditary. Mr. Greenish relates an interesting example of this in 'Brit. Med. Journ.' June 26, 1880. But such cases should be watched with some apprehension, for malignant disease may afterwards sprout out of the fractured part,[3] or strumous deposit may make its appearance elsewhere. Spontaneous fracture from any cause does not preclude the possibility of repair, but in cancer amputation is required unless (as is very commonly the case) there are other cancerous deposits elsewhere. In all the other cases the surgeon should incline to preserve the limb, though in extensive necrosis, and especially in the lower limb, the attempt will very probably fail.

[1] Curling, 'Med.-Chir. Trans.' vol. xx.

[2] Lectures on Diseases of the Nervous System. 'New Syd. Soc. Trans.' ii. 315.

[3] A bone which gives way near a cancerous tumour may nevertheless unite. See 'Path. Trans.' vol. xi. p. 219. A man was admitted into St. George's Hospital with malignant disease of the humerus. The bone had given way at that spot ten months before, but the fracture had united before the tumour was noticed.—'Path. Trans.' vol. x. p. 249.

CHAPTER XXIII.

DISEASES OF THE JOINTS.

Diseases of the joints are described for convenience' sake under the head of the tissue thought to be chiefly or at least most obviously affected, and are therefore divided into diseases of the synovial membrane, of the cartilages, and of the articular ends of the bones. The classification is, no doubt, an imperfect one; in fact, the affections of the ligaments, including the fibrous capsule of the joint, are almost passed over in most of the formal treatises, though I, for one, have no doubt that they are very commonly the starting-point of inflammation which destroys the whole articulation. It appears to me that one of the most useful ways of regarding the subject for practical purposes is to consider joint-diseases under two chief heads, viz. diseases originating in the bones and spreading outwards or towards the surface, and diseases originating in the synovial membrane or capsule, and spreading inwards or towards the bones.[1] Another very important division of joint-diseases is into acute and chronic, a distinction which more than anything else governs our prognosis and treatment. Thus, cases will be met with, though fortunately not often, in which the disease comes on with very formidable symptoms, acute traumatic fever, rapid suppuration and disintegration of the joint, speedily terminating in death, either by exhaustion or by pyæmia; whereas the great bulk of the diseases of the joints which we are called upon to treat are accompanied by no constitutional affection whatever and involve no danger to life. They often cause loss of activity and of all that makes life worth having to the possessor, and from that consideration may justify operations which are extremely dangerous. But in making up his mind to perform such operations the surgeon should never omit the consideration that the disease exposes the patient to little or no danger, while the operation is very dangerous indeed. Those surgeons who use this as an argument for never performing amputation or excision in chronic joint-disease are in my opinion wrong, since the natural cure often takes many years, during which the patient, if a poor man, is debarred from earning his livelihood, and in any case from all enjoyment of his life; but there is no doubt that such operations are always to be regarded rather as operations of expediency than necessity. This does not of course apply to cases in which the suppuration is visibly pulling the patient down, or in which hectic has set in, and where the surgeon has reason to fear that the delay of amputation or excision may involve danger to the patient's life.

Disease of the joints.

The symptoms of acute synovitis are pain, inflammation (as shown by increased heat of the part), and fluid effusion into the synovial capsule. The disease is due either to injury or to rheumatism in most cases, and the pain varies accordingly. It is usually distensile and burning in the most acute cases, but is not complicated with those painful spasms which are characteristic of the more deeply seated affections. In cases of acute

Synovitis.

[1] See 'Surg. Treatment of Children's Diseases,' 2nd ed. p. 411.

synovitis, the synovial membrane is injected and its capillaries are distended, the synovial fringes show cells in process of proliferation, and with distinct nuclei in which one or more nucleoli are perceived. The synovial fluid is found to contain a number of cellular elements, some being in all respects like pus-globules—others containing one or more nuclei. Cornil and Ranvier describe in the protoplasm of these cells fatty masses which are sometimes so abundant as to obscure all the rest of the cell. The number of these cellular elements corresponds to the greater or less turbidity of the fluid. In chronic cases the effusion may resemble the natural synovia in all other respects, but is much more in quantity. Flakes of a mucous substance (likened by Cornil and Ranvier to sputa) are generally to be found in the fluid, and under the microscope the cellular elements are seen to be enclosed in a fibrinous network. Detached and disintegrated epithelium may also be found in the fluid, and more or less blood in some acute cases. In very acute cases the synovial membrane has been found partly destroyed by ulceration. In recent acute cases, before the sac has become too tense, the sense of fluctuation is very plain, and the form of the swelling, taking as it does exactly the shape of the synovial membrane, is perfectly characteristic. Thus, in the knee-joint there is a fluctuating swelling extending up the limb for some distance in front of the femur, bulging on either side of the patella, more prominent on the inner side, and floating the patella up as if in a water-bath. On the other hand, the shape of the swelling which is due to enlargement of the bones or of the fibrous tissues which invest them, is an exaggeration of the natural outline of the bones. It raises and pushes forward the patella, but that bone remains still in contact with the femur. This form of swelling also is never developed so rapidly as synovial effusion often is. But it must be remembered that some amount of periosteal effusion or swelling of the bones themselves is often mixed with synovitis.

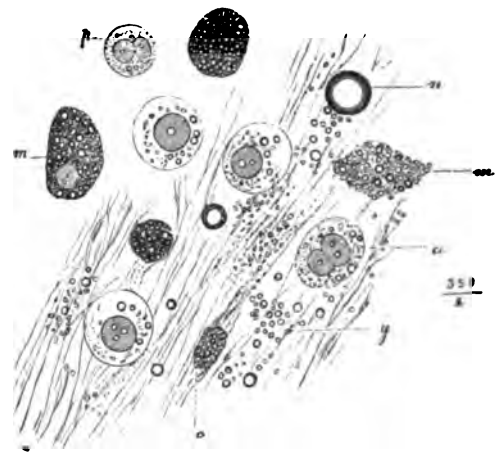


FIG. 215. Mucous and fibrinous elements of the fluid in acute rheumatic synovitis. *a*, a large cell; *m*, granular bodies resulting from the fatty transformation of the cells; *n*, drop of free fat; *p*, globule resembling pus; *g*, fibrinous network enclosing the cells and fatty masses. From Cornil and Ranvier.

Mr. Morant Baker[1] has called attention to the fact (of which I recently saw a striking example) that 'in cases of effusion into the knee-joint, and especially in those in which the primary disease is osteoarthritis, the fluid secreted may make its way out of the joint, and form by distension of neighbouring parts a synovial cyst of large or small size.' And he gives some striking drawings and cases showing that such cysts may form not only in the situations of the common bursæ, but also in comparatively remote parts of the leg, 'not approaching within 8 or 4 inches of any part of the knee-joint,' and not having any perceptible communication with it, and also showing that they may entirely disappear. The obvious inference

[1] 'St. Bartholomew's Hospital Reports,' vol. xiii. p. 245.

is that such cysts should not be punctured or otherwise submitted to operation without strong reasons.

The causes of synovitis are blows and sprains, exposure to cold, rheumatism, gout, gonorrhœa, and pyæmia or blood-poisoning. Gonorrhœal and pyæmic synovitis will be found treated of under the diseases of which they are symptoms. The surgical treatment of gouty synovitis is much the same as that of the rheumatic form of the disease. Cases also occur of syphilitic affection of joints in which the synovial membrane becomes implicated, but secondarily to affections of the bones or fibrous structures.

The usual course of synovitis is towards recovery, if the parts are left at rest. There are, however, exceptional cases, and chiefly those following on penetrating wounds of the joint, which will go on to suppuration and disorganisation (so-called 'abscess') of the joint. Using still the knee-joint for illustration, the symptoms of such abscess are as follows: High traumatic fever, rigors, great pain and starting of the limb, œdema and inflammation of the soft parts covering the joint, with considerable rise of local temperature, exquisite pain on motion; and, if the part be not well supported, displacement of the bones of the leg backwards will rapidly ensue. Acute abscess

Acute abscess is a formidable malady, due very commonly to injury, though it may occur spontaneously in weakly young persons. The abscess may either commence in the soft tissues around the joint, bursting into its cavity and causing rapid disintegration, or in a wound of the joint, or in acute synovial inflammation, or as the consequence of an abscess which, forming either in the bone or in the thickness of a degenerated synovial membrane, has made its way into the cavity of the joint.

The treatment ought to be decided, and for that purpose an exact diagnosis is necessary. This must be made by an exploratory puncture, for which the aspirator is the most convenient instrument. Should the fluid be only slightly purulent, or should there be no pus at all, there will be no harm in withdrawing the whole or greater part of the fluid, and carefully closing the puncture; but if the joint contains pus pure, or nearly so, an exit must be given to it, and this is done either by a free incision or by passing a drainage-tube through the joint. The former is the course usually recommended and adopted, but it is a very severe measure in the case of the knee-joint, at any rate in adults. In children I have frequently seen the knee-joint opened with success, but the great majority certainly of the cases which have come under my own notice in later life have proved fatal from traumatic fever or pyæmia. Since the introduction of the antiseptic treatment, however, the treatment of abscess, or entire disorganisation of the large joints by free incision, has become much more active, and I believe much more successful; and many of these cases have been reported as having been brought to a favourable issue by laying the joint open as freely as in an excision, and treating the wound on the antiseptic method. Still, I believe that in the case of persons whose general health and constitutional vigour is not very favourable, amputation would often be the more prudent course. After incision of the joint if things go well the joint will ankylose—in early life perhaps so incompletely that considerable motion will be preserved. Indeed, in one case of a child in whom I opened the knee-joint very freely hardly any impairment of motion was perceptible after her recovery. But in adults the joint will usually be stiff.

If the case is to do badly the fever increases, the discharge becomes more foul, and the limb more swollen and painful. If the surgeon has used a

drainage-tube or made a small puncture he may be inclined to try the effect of freer incisions, failing which his only resource is to amputate; but amputations under these circumstances are very unpromising, and, if definite symptoms of pyæmia have set in, are almost hopeless.

Treatment of synovitis.

In the acuter forms of synovitis the effect of local blood-letting is generally very beneficial. The fluid may often be withdrawn through an aspiration-puncture with marked benefit. Mr. Barwell strongly recommends a subcutaneous incision into the synovial membrane, if the fluid is too thick to flow through the needle. The limb must be put up in an apparatus which will keep it perfectly at rest, for which purpose, in the case of the knee, some support must be given in the ham by means of a pad or stuffing, or by a bend in the splint. Ten or a dozen leeches may be applied, and the bleeding encouraged by fomentation afterwards, and then cold must be assiduously employed; or, if cold is not well borne, the application of a large poultice enveloping the limb is often very grateful. 'Leiter's tubes' form a very convenient method of applying cold.[1] In many cases, if the morbid action is not too acute, the pressure of an elastic bandage is very useful, and the cold can, if necessary, be applied outside this.

For more chronic cases, or when the acute has given way to chronic inflammation, complete local rest and blistering are the measures chiefly indicated; and in the last stage of the disease, when little is left except a little indolent swelling, pressure is very useful. This is often made by a case of strapping, inside which a layer of camphorated mercurial ointment is placed, and the whole supported by a bandage, which can be gummed if necessary (Scott's bandage); but strapping and bandage in the ordinary way answers well enough. When the patient discards this and gets about without any application, gentle shampooing and friction will be useful in removing any remains of swelling.

Hydrops articuli.

To the most chronic form of synovial effusion the name of 'hydrops articuli' has been given. It forms a large fluctuating swelling, devoid of heat or pain. It is almost confined to the knee-joint, and the patient requires relief from the condition on account of the stretching of the ligaments and consequent insecurity of the joint, rendering the limb useless. The fluid differs from that of common synovitis in containing little if any lymph; but it coagulates with heat, like the fluid of hydrocele. The limits between chronic synovitis and hydrops articuli are difficult to fix; consequently, if there is any prospect of improvement from the milder methods of treatment used in chronic synovitis—rest, blistering, pressure, absorbent ointments, and aspiration—a careful trial must be given to such measures. But when these have failed, or if the complaint is so inveterate as to render them obviously useless, the joint must be injected with iodine. The tincture of iodine has been injected in equal proportions with water, ℥ss of the mixture, or ℥iij—iv of a weaker solution—one part of the tincture to four of water—as much of the fluid as possible being allowed to escape afterwards. Care must be taken

[1] This is a very useful application, and far superior to the icebag in almost all cases where the local application of cold is indicated. A tube of flexible metal is bent into a coil of parallel tubes so as to form a kind of pad, and the shape of this pad can be easily adapted to that of the part which is to be refrigerated. One end of the tube communicates with a basin of ice-water placed beside the patient's bed, the other with a pail under the bed. The iced water runs slowly through the coil, and cools the part effectually without producing any moisture, and with the great advantage of maintaining a uniform temperature: while the icebag (unles the nurse is more than ordinarily careful) will frequently be found full of warm water.

to exclude the air, and the puncture must be carefully closed, and strapping and bandage applied on a splint. If severe reaction follow, as may easily happen, the case may be converted into one of acute abscess. But generally it does well and the patient recovers, with more or less stiffening.

Pulpy degeneration of synovial membrane.

The synovial membrane becomes more or less thickened in all cases of chronic synovitis, but this thickening disappears in the course of time, and no remains of the disease are to be found ultimately in favourable cases. It does happen, however, not uncommonly that the swelling persists as an indolent pulpy thickening, taking the shape of the capsule of the joint, giving here and there an obscure sense of fluctuation, which on puncture is found to be deceptive, but possibly in other situations really fluctuating, either from synovial fluid in the joint-cavity or from pus contained in the thickness of the diseased membrane itself. Such abscesses may break into the joint and set up acute symptoms, or they may burst externally, and a sinus may remain which frequently shows no tendency to heal.

On examination the synovial membrane is found to be converted into a pulpy, gelatinous, pinkish-grey mass, which on its free surface somewhat resembles granulation-tissue. There are often small abscesses scattered through its substance, and pus is frequently found in the articular cavity. The cartilages may be eroded and the bones carious, but the disease in the synovial membrane may have existed for a long time without any such morbid appearances.

The persistence of the disease hinders the use of the joint, and as the thickening increases the ligamentous capsule becomes distended, the bones pushed away from each other, the interarticular ligaments stretched and softened, more or less displacement follows, and the limb is permanently crippled.

The nature of this affection is not absolutely settled. From its incurable nature Sir B. Brodie was at first disposed to regard it as malignant; but this it certainly is not.[1] Others, with more probability, have considered that it is 'strumous,' but of this there seems no satisfactory proof, although some pathologists believe that they have recognised miliary tubercles in, or on the surface of, such degenerated synovial membranes.[2] It is not proved to have any specific character, or to be anything more than the result of chronic inflammation, acting perhaps on a person debilitated by low living or by other unfavourable circumstances, of which the strumous constitution may be one.

The diagnosis does not generally present any great difficulty, as the long persistence of the disease, the absence of proof of any mischief about the bones, and the shape of the swelling, will pretty certainly exclude any other supposition.

If there is no motive for immediate interference the cure of the disease may be sought by steady, gentle pressure (as by Scott's bandage) and the improvement of the general health; but I am not sure that the pulpy thickening, when it has once reached a high degree, so as to constitute of itself a substantial disease, is ever entirely removed, and then the choice lies between allowing the patient to remain content with his infirmity or removing the joint by amputation or excision, according to the age of the patient. Such

[1] Nor was this Brodie's latest opinion. He was more disposed to regard it as generally the result of chronic inflammation, though there were cases in which he thought this explanation difficult.—See 'Diseases of Joints,' ch. iii. Brodie's Works, by Chas. Hawkins, vol. ii. p. 167.

[2] See especially Croft, 'Path. Trans.' vol. xxxii. p. 174.

cases are particularly favourable ones for excision in early years. Latterly we have attempted the cure of this affection by destroying the degenerated synovial membrane with sulphuric acid, and so procuring ankylosis, in the same way as caries is treated (see p. 423), and by the injection of dilute carbolic acid, or of the ethereal solution of iodoform, or by the direct application of iodoform stuffed into incisions made in the thickened membrane. I hardly think these measures have been sufficiently tried to enable us to express a definite opinion of their use, though in obstinate cases they are in my opinion quite justifiable. In private practice especially there is no motive for haste in the treatment of such cases. Displacement of the bones should be remedied or corrected, properly-contrived support furnished, and the reduction of the swelling sought by pressure and mercurial ointment or the ung. iodi or empl. galbani.

Pendulous growths from synovial membrane.

In some cases the synovial membrane is found studded over with a number of loose pendulous fringes. A most beautiful preparation exists in the Museum of St. George's Hospital, which has been figured in various works on the joints, and which shows this condition in its highest grade. The growths are variously regarded as being the products of simple inflammation or as one of the phenomena of rheumatic arthritis. Probably both views are correct in different cases. Certainly such pendulous growths may form, isolated or in small numbers, in simple inflammation, and may become loose in the joint (loose cartilages); while Dr. R. Adams has given good reasons for believing that in one at least of Sir B. Brodie's preparations of this condition the disease was of the nature of rheumatic arthritis, since the state of the cartilages and bones and the history exactly corresponded with the usual phenomena of that affection.

Diseases of the articular ends of bones.

The diseases of the articular ends of the bones are very common, and are the source from which the great majority of the cases spring which end in total disorganisation of the joints. Like diseases of bone in other situations, they may either be regarded as inflammations, acute or chronic, periosteal or endosteal, and tending to caries or necrosis; or else an attempt may be made to refer them to the causes from which they are supposed to originate, and thus to classify them as traumatic, strumous, rheumatic, syphilitic, &c. Both classifications have their practical utility, but it is only in certain well-marked cases that either is possible. It is, for instance, of the greatest practical importance to recognise the undoubted fact that in many cases necrosis of a limited portion of the articular end of a bone occurs, and that in such cases the limb may be saved by the timely extraction of the sequestrum (see Fig. 196). It is only rarely that we can be certain of the existence of such a sequestrum before cutting into the joint; but a knowledge of the fact might in some instances lead to an exploratory incision which would save a limb that would otherwise have been amputated.

Again, it would be very important were it possible to distinguish cases in which the disease of the bones leading to disintegration of a joint is due to constitutional affection, such as struma, from those in which it is the mere result of chronic inflammation after injury. But nothing is more difficult. I have given reasons elsewhere[1] for the opinion which I formed from the results of an extensive observation of joint-disease in childhood, and which subsequent experience has strengthened, that the common expression 'strumous disease,' which is applied as a matter of course to pretty nearly every chronic joint-

[1] 'Surg. Dis. of Childhood,' 2nd ed. p. 424.

affection not owning any obvious cause, is erroneous and misleading—erroneous in theory, since such cases constantly occur in persons who show no symptoms of any strumous affection, and in whose bodies on dissection no lesion of any kind is detected to which the term strumous can be applied; and misleading in practice, since the assumption that such diseases are constitutional, and therefore can only be eradicated by general treatment, is contradicted by the fact that the total removal of the affected joint is often followed by complete and permanent recovery. I have shown[1] that out of a large number of cases of excision or amputation of diseased joints—which would all, I think, have been classed in the ordinary nomenclature, as 'strumous'—no recurrence of the disease nor any other symptom of struma occurred during several years in the great majority.

In saying this I by no means deny that strumous children and other strumous persons are very liable to such chronic affections of the joint-ends of the bones. All that I assert is that a large proportion (I believe a large majority) of those affections are independent of any constitutional cachexia, and originate, as far as we can judge, either from local injury or from exposure to cold or wet.

Acute arthritis of infants.

Mr. T. Smith has shown, in a very interesting paper, 'On the Acute Arthritis of Infants' ('St. Barth.'s Hosp. Reports,' vol. x.), how frequently the ends of the bones are the seat of disease in the earliest periods of life—sometimes from the formation of abscess beneath the articular lamella of the bone, which subsequently bursts into the joint and destroys it, at others from more universal acute inflammation of the whole extremity of the bone. This acute and rapidly destructive affection has no connection with syphilis (see page 394), nor as far as is known with struma. Occurring in very early life it is usually fatal, but in older and stronger children recovery seems not uncommon, and even recovery with a useful limb.

The usual symptoms of chronic disease of the ends of the bones is an indolent swelling, taking the form of the joint-ends, occurring generally after some slight injury, and complicated frequently with more or less synovitis. After a time inflammatory symptoms make their appearance, viz. deep-seated pain, starting of the limb, abscess exposing the bone, which is found to be softened and carious, and finally dislocation (or, as it would perhaps better be called, displacement) from destruction of the ligaments. If the patient recovers, the joint becomes ankylosed, or else the constant discharge breaks down the health, and he dies either from the direct effects of the disease or from some intercurrent malady. The disease, however, may be arrested at any stage. In its earliest stage, when there is nothing abnormal except some indolent swelling of the joint-ends, this swelling is due partly to enlargement of the bones themselves, but in a great measure to effusion beneath, in, and around the periosteum. Bones in this condition will be found somewhat increased in bulk, but much diminished in consistence, their cancelli enlarged and filled with inflammatory products in various stages, and possibly containing crude tubercle,[2] though this has been in my experience a very rare appearance; and as a general rule one sees only the ordinary phenomena of the softening stage of ostitis. This may subside under the influence of prolonged

[1] 'Lancet,' Feb. 24, 1866.

[2] See the drawings from Sir B. Brodie's case of deposit in the head of each femur, p. 429. I would refer to Mr. Macnamara as an author who believes in the frequent deposit of tubercle in bones, and to Mr. Barwell who altogether denies its existence ('Dis. of Joints,' 2nd ed. p. 333), as a proof of the difficulty of the subject in the present condition of pathology.

rest, slight counter-irritation, and attention to the state of the general health. Local rest is of the most vital importance, but it is of equal importance that the general health should not break down under prolonged confinement, so that if the patient's circumstances allow of it he should have plenty of fresh air. The patient or his friends should be warned that permanent benefit can only be expected after a very long period of treatment, and that ultimately the joint will most likely be ankylosed, more or less entirely.

If the case goes on badly, and suppuration ensues, it becomes necessary to examine the joint carefully and thoroughly under anæsthesia. Nothing can be worse than to irritate diseased joints unnecessarily by repeated examination; but a clear idea of the actual state of the parts can be founded only on a thorough exploration, when a decided line of treatment should be at once adopted. The main questions in such cases are whether the bones are exposed or the suppuration is external to the joint altogether, or in the thickness of diseased synovial membrane, and whether there is a sequestrum in the articular surface. If the cartilages are destroyed and the pus is furnished by the carious articular ends there will be extensive crepitation in every passive movement of the joint. In extra-articular abscess the joint-ends will move smoothly and naturally on each other. If a limited portion of bone only is exposed the crepitation will only be perceptible in certain movements, and the presence of a sequestrum, or loose portion, can be judged of partly by the limitation of swelling to that part of the joint and the direction of the sinuses, but cannot be confidently affirmed before incision.

When the condition of the joint has been ascertained the treatment will depend on the extent of disorganisation of the joint, on the patient's condition, and on the rate of progress of the disease. If the bones are so far displaced, as well as diseased, that the limb could be of no use, even if the disease were arrested, amputation is of course indicated; so also if the patient is not in a state to bear the necessarily protracted treatment, or if acute traumatic fever has exhausted him and threatens a fatal result; and in patients at all advanced in life, if the diseased joint requires removal, it must be done by amputation. In children and young persons excision may be practised. The indications for excision will be found discussed in the concluding chapter. Here it will be sufficient to say that (at any rate in all the joints of the lower extremity) extensive affection of the bones, visceral disease, a period of life beyond 40 (except in the rarest cases), and any acute symptoms connected with the articular affection, are absolute contra-indications to excision, whilst in the case of the elbow much more may be risked, and in that of the shoulder also, if any operation is necessary, although here it is usually more advisable to attempt nothing beyond the removal of sequestra or the solution of carious bone by caustics. The treatment of the diseased joint, however, by free incision, as described on p. 453, or the combination with this of the application of strong sulphuric acid as recommended by Mr. Haward,[1] may possibly save many joints which would otherwise have been excised, and thus preserve the length and future growth of the limb, and at less risk to life. This operation consists in making two long incisions on either side into the articulation, wiping out from the joint all the pus and lymph which it may contain with strips of dry lint, and then filling its cavity with lint soaked in a mixture of one part of strong sulphuric acid and two parts of water. This cauterises and destroys all the diseased synovial membrane and the cartilages, which come away as sloughs. The carious bone is also disintegrated and comes

[1] 'Clin. Soc. Trans.' vol. vi. p. 13.

away, and then the exposed bony surfaces granulate, and osseous ankylosis ensues. But I must confess that a fatal result has attended a good many of the cases in which the sulphuric-acid treatment has been tried, and the relative success of the treatment by incision has still to be tested by experience. It is of course inapplicable except in cases where the disease in the bones is judged to be quite superficial. Iodoform has lately been used in somewhat the same way.

Diseases of the cartilages.

The disease to which the name of 'ulceration of the cartilages' was given by Brodie, and to which it is usually applied, is a very definite and easily recognisable affection, and one to which the designation is, doubtless, so far appropriate that the cartilages will always be found to be ulcerated. But whether that ulceration is the essence of the disease, or only one of its invariable concomitants, may very reasonably be doubted. In my own opinion, and, I believe, in that of most surgeons of the present day, the affection of the cartilages plays really a very subordinate part in the disease.[1]

This affection is characterised by the usual symptoms of inflammation of the joint, but especially, and besides these symptoms, by the peculiar painful startings of the limb and the acute localised agony which is produced by pressing the joint-surfaces together, and in the worst cases by the slightest movement or jar communicated to the limb. The spontaneous startings occur usually at night, just as the patient is falling asleep; often they wake him from the deepest sleep, and they leave acute pain, lasting long afterwards, and accompanied sometimes by severe sweating. With these prominent and agonising symptoms there is often very little swelling or synovial effusion, though in other cases the symptoms of ulceration of the cartilages follow on a regular attack of synovitis, but more commonly the preceding symptoms are those of affection of the articular ends of the bones.

The after-progress of the disease is in one of three directions: (1) the symptoms may subside, leaving a little loss of motion at first, which afterwards almost entirely disappears in some cases and persists in others; (2) the joint may be dislocated, abscesses may form, leaving sinuses through which the bone is exposed, and the case pursues the usual course of chronic disorganisation of the joint; or (3) acute abscess may form in the cavity of the joint, in which case the patient usually sinks from pyæmia or irritative fever if the limb be not removed.

The pathology of this disease seems to be as follows: In the cases in which it commences as synovitis, the inflamed synovial membrane is converted into a pulpy mass, resembling, if not identical with, granulations. The granulations advance over the surface of the cartilage, and propagate inflammation to it; so that when the inflamed synovial membrane is lifted from the surface of the cartilage little ulcerated pits are found, which have been worn into the cartilage by the granulations of the synovial membrane. The inflammation spreads through the cartilage to the subjacent bone. In the more ordinary cases the course of the inflammation is the reverse. From the inflamed bone it spreads through the cartilage to the synovial membrane.

The appearances of inflamed cartilage to the naked eye consist in the

[1] 'Nothing can be more sure than that, of all the joint-diseases which fall under the surgeon's notice, not one originates in the cartilage.'—Barwell, 'Dis. of the Joints,' 2nd ed. p. 399. 'There is no primary disease of this structure' (sc. Cartilage). 'All the changes that are to be found in it are secondary to some other affection, and in the generality of cases to disease in the articular extremities of the bone.'—Bryant's 'Practice of Surgery,' 2nd ed. vol. ii. p. 423.

formation on its surface of ulcerated spots, where the cartilage is removed in a part or the whole of its thickness, and in a degeneration of its substance, which becomes fibrous (so as to be compared to the hairs of a small brush or to the pile of velvet), and in some cases thickened and softened in texture. The union also between the cartilage and the bone becomes much loosened, so that the cartilages are in some places quite detached, though still lying over the bone; or pieces of the cartilage may be detached and free in the joint.



FIG. 216. Acute inflammation of cartilage. After Redfern.

Examined by the microscope two kinds of change are seen in such cases. In one which is more distinctly inflammatory the nuclei of the cartilage-cells increase in size, and divide so as to increase in number; the contents of the cell become granular; the cells enlarge at the expense of the hyaline substance, which is ultimately absorbed, and then the cells burst, setting free their contained nuclei, which have become transformed into bodies resembling pus-corpuscles. Fig. 185, p. 412, will show that here also, as in the bones, large many-nucleated cells are found which hardly look as if they had been formed by the proliferation of the cartilage-cells (as those in fig. 216 are) but rather as if they had been formed in the medulla of the neighbouring bone and were engaged in eroding the substance of the cartilage. The same figure shows the intercellular substance calcified, a change very usually found, but the precise significance of which is not yet clear.

In the other change, which partakes more of the nature of degeneration, the intercellular substance is not destroyed, but is rendered granular, and the cartilage-cells are separated from each other by a fibrillated material, which is probably developed from the nuclei of the cartilage-cells by a process of proliferation. Rindfleisch[1] has depicted in these more chronic instances of inflammation canals extending through the cartilage from the granulations on the articular lamella to those on the synovial membrane into which vessels shoot which bring these two layers of granulation into contact.

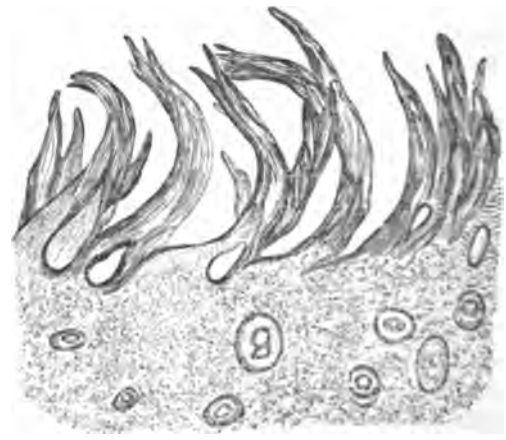


FIG. 217. Vertical section of inflamed cartilage, showing the splitting into fibres of its surface.—From Redfern.

These more chronic changes depend, as it seems, partly on loss of nutrition from the loosening of the connection between the cartilage and the bone.

[1] 'Pathological Histology,' New Syd. Soc. Trans. vol. ii. p. 260.

This slight sketch of the morbid anatomy of inflamed cartilage, which ought to be supplemented by a study of the works named in the footnote,[1] will, it is hoped, enable the student to understand what has been said about the symptoms and the results of the disease called 'ulceration of the cartilages.' The mere erosion of the cartilages themselves does not produce any special symptoms—at least that is the opinion of almost all surgeons of the present day[2]—and the grievous starting pains which characterise the disease are produced by pressure on the inflamed bony surfaces which are exposed by their removal. Sir B. Brodie himself came to this conclusion, and has expressed in the latest edition of his work the opinion 'that the increased sensibility in these cases is in the bony plate beneath the cartilage rather than in the cartilage itself; and that the presence of severe pains with involuntary startings of the limb is always to be regarded as a sign of the bone partaking of the disease.'[3] If any further proof of this be wanted it may be found in the fact that similar pains and startings often take place after excisions of the knee and elbow, when every portion of the cartilage has been removed, though they are not so severe as in joint-disease, partly, perhaps, because in excision the sensitiveness of the bone where it has been divided is less than that of the articular lamella, and partly because the muscular action is interfered with by the wound. For there can be no doubt that the spasms which produce such agony in ulceration of the cartilages are due to reflex irritation of the muscles, bringing the inflamed end of the bone into contact either with cartilage opposed to it, or, what must be far more painful, with another inflamed portion of bone.

1. The various events which we have just noticed are easily understood from a consideration of the anatomy of the disease.

When the disease subsides after the cartilages have been ulcerated and the bone only somewhat inflamed, no pus, or no considerable amount of pus, having been effused into the articulation,[4] the ulcerated spot may fill up by means of fibrous tissue, and possibly no ankylosis whatever may take place; or if a slight fibrous band or bands should form between the ulcerated spot and the opposite surface of the joint it may give way. The formation of these fibrous bands is easily understood from the tendency to fibrillation observed in the articular cartilage in inflammation and the rapid development of vascular channels in it.

2. When the suppuration has been more considerable but chronic, it will make its way to the surface, leaving, in all probability, some part of the bone

[1] Redfern, 'Abnormal Nutrition of Cartilage.' Barwell, 'Diseases of the Joints.' Weber, 'Ueber die Veränderungen der Knorpel, &c.' 'Virchow's Archiv,' Jan. 1858. Rindfleisch, 'Path. Anat.' vol. ii. pp. 250, 260. A. E. Barker, in 'Syst. of Surg.' 3rd ed. vol. ii. p. 348.

[2] Redfern says: 'Most extensive disease may be going on in many joints at the same time, and may proceed to destroy the whole thickness of the cartilage in particular parts, without the patient's knowledge, and while he is engaged in an active occupation.' I once saw a striking ocular demonstration of the utter painlessness of ulceration of the cartilage. I had amputated at the knee-joint in a case of injury, leaving the whole of the cartilage covering the femur intact. Unluckily my anterior flap (which had been injured in the accident) sloughed, and the end of the femur covered by its cartilage lay exposed. We watched the cartilage melt away by ulceration during many days till the whole bone was denuded. The patient remained quite insensible to the process.

[3] 'Works,' by Charles Hawkins, vol. ii. p. 244.

[4] Several interesting cases will be found recorded by Brodie, in which ankylosis apparently complete has ensued on ulceration of the cartilages, without any formation of pus. See especially the case numbered xliv. on p. 242 of the second volume of his collected 'Works,' edited by Mr. Charles Hawkins.

exposed; and as the suppuration progresses the ligaments are inflamed and softened, so that the interarticular ligaments are apt to give way, and the capsule to yield to the pressure of the bone, now displaced by the muscular action, and so dislocation will ensue if great care is not taken.

Finally, the occurrence of acute suppuration in the joint needs no explanation, since pus is furnished not merely by the cartilage but in far greater quantity by the granulations on the inflamed synovial membrane and bone.

The treatment of this acute inflammatory disease is at the present time less active than it used to be; but still though we have, perhaps, been wise in giving up the excessive local bleeding and counter-irritation and the free administration of mercury which was in vogue some years ago, we have abundant opportunities of testing the value of more moderate antiphlogistics and counter-irritants in the form of the free application of leeches, blistering, or issues. The strictest local rest should be at the same time enforced. If the joint is too irritable to bear a splint it should be supported on all sides by some soft substance, such as a junk well padded with tow or cotton-wool sufficiently to prevent any serious displacement; or if such displacement has taken place before the case is seen the limb should be at once put into as good a position as possible under anæsthesia. The free administration of opium to such an extent as will relieve the pain is necessary. In robust persons with high inflammation I have often seen great improvement from a course of mercury rapidly administered; and although conscious of the evils which follow the indiscriminate use of mercury, in such cases I venture to recommend it.

The necessity for amputation arises when the symptoms of abscess in the joint are plain, and when in the surgeon's judgment the patient has not strength to survive the opening of the abscess—as to which enough has been said above (p. 453).

Excision is not successful, and should not be practised in these acute conditions of inflammation in the lower limb; but in the upper limb there is no such objection, and I have more than once excised the elbow with success in the acute stage of the disease.

Other degenerations of cartilages.

There are other degenerations of the articular cartilages, as hypertrophy, atrophy, fibrous, fatty, and calcareous degeneration; but they produce no known symptoms during life, and I must therefore refer the reader to works on pathological anatomy for their elucidation. The extensive changes thus found in the cartilages, with no symptoms during life, strengthen the opinion that in the destructive disease called 'ulceration of the cartilages' the condition of the latter is really a subordinate feature.

Loose cartilages.

Loose 'cartilages,' or, as some prefer to call them, 'loose bodies' in the joints, are sometimes numerous. They are seen almost but not quite exclusively in the knee-joint. Rare cases are recorded and preserved in the elbow and other joints, but they are rather surgical curiosities than matters of practical interest. The following will, therefore, apply to the disease as found in the knee.

Many of them are not really cartilaginous—at least, if there is any true cartilage in them it is in such small quantity as to escape even a careful examination. The bulk of the body consists usually of fibrous tissue, in which perhaps a small cartilaginous nodule may be found, and the cartilage is sometimes extensively or almost entirely calcified. In other cases, however, they have been found cartilaginous throughout, and in some true bone forms a part or

the whole of them, and I have seen a case in which the supposed loose cartilage turned out to be a piece of semi-solid lymph.[1]

The causes which produce these loose bodies will throw some light on their anatomy. Hunter believed[2] that they often arise from contusions in which blood is effused into the joint; and this blood becoming organised and then being separated from the inner surface of the synovial membrane, gives rise to the loose body. And although modern pathologists may hold different views from Hunter about the frequency of organisation of blood-clots or the manner in which it occurs, it cannot be doubted that accident is a frequent cause of loose cartilage. This accident may possibly produce extravasation into some of the fringed processes of synovial membrane in which it is well known that minute portions of cartilage may often be found. If such extravasated fringes become subsequently thickened by inflammation, their attachment to the main portion of the synovial membrane may become gradually looser, until at length they drop completely into the cavity, and then would be found to present exactly the structure generally seen in a loose cartilage. And this explanation of their origin is also consistent with the fact that they are frequently found not perfectly loose, but pedunculated. In other cases, however, there is no doubt that they originate spontaneously from the detachment of similar fringed processes, which in some persons are found unusually large and numerous,[3] or they may and often do originate from disintegration of the cartilages in chronic rheumatic arthritis, and possibly in other affections of the joints, though in these cases they are seldom made the subject of any special treatment, the existence of the loose body being only a subordinate feature of the case. Finally, there are cases (though probably not very many) in which a piece of the articular cartilage or even of the articular end of the bone may be knocked off, and fall as a loose body into the joint.[4]

The symptoms which they produce are acute pain when the foreign body gets between the ends of the bones in the movements of the joint, often followed by more or less synovitis, so that the limits of the joint are somewhat extended. The loose body is often plainly to be felt in the sac of synovial membrane which extends in front of the femur, and then may fall into the back of the joint again and perfectly disappear. The patient usually is quite conscious of its presence, and can often bring it into reach when the surgeon cannot.

Operations for loose cartilage.

In the treatment of this affection it is necessary, I think, to bear in mind that the knee-joint cannot be opened without grave danger. Therefore in persons whose occupations are not active, and who do not suffer much from the presence of the foreign body, it may be more prudent to temporise with the disease by fixing the loose cartilage if possible in the upper sac of the synovial cavity, where its presence is comparatively harmless. This may sometimes be accomplished by circular strips of strapping fixed above and below it, or by a bandage with a hole to receive it, and it is even possible that

[1] Brodie ('Works' by C. Hawkins, vol. ii. pp. 288, 289) relates two interesting cases in which the symptoms of loose cartilages were produced by 'fleshy tumours' attached to the synovial membrane, which were operated on with success. The structure of these tumours is not very accurately described, but one of them at least is distinctly asserted to have been traversed by vessels.

[2] Hunter's 'Works,' vol. i. p. 520, and vol. iii. p. 625.

[3] See the figure on p. 337, vol. ii. 'Syst. of Surg.' 3rd ed.

[4] See the cases of detachment of a piece of cartilage, related by Mr. Teale, 'Med.-Chir. Trans.' vol. xxxix. p. 31; by Mr. Brodhurst, 'St. George's Hospital Reports,' vol. ii. p. 141; and of detachment of a portion of the bone along with the cartilage over it, by Mr. Simon, 'Path. Trans.' vol. xv. p. 206, by Brodie, vol. ii. p. 284, and by Nélaton, 'Path. Chir.' ii. 182.

... where it can be seen. It will, of course, be ... are restrained meanwhile by a ... Attempts have been made to fix the loose body ... the muscles of other parts through it, but not, I believe, with ... This is most easy, where the joint is otherwise healthy ... if the loose cartilage becomes ... affected in the two ways. In both the body must be ... the forefinger and thumb placed under it, or if ... steadied by means of a needle. Then in the *direct* ... the knife is thrust down on the loose substance and gently ... it with its finger and thumb, so as, if ... the escape of synovia from the joint. And in order that ... may be easy, it is well to have previously drawn ... the loose cartilage, so that when the parts return to ... the skin-wound no longer corresponds to the opening in ... The method which is believed to be more safe, ... is that in which a tendon-knife is passed ... the loose body and a bed or cavity formed for it in the ... This is then made into the capsule of the joint, ... may be squeezed into the subcutaneous tissue. ... of it, if it causes any inconvenience, until the ... can be cut down upon and extracted. ... experienced in squeezing the body out of the joint, ... is often not absolutely loose but pedunculated. An ... reported by Sir W. Mackenzie ('St. Thomas's Hospital ... vol. v. 1874) in which he finally succeeded by vigorous ... in capturing the pedicle and pushing the loose body ... case also illustrates another point in the surgery of loose ... The loose body often diminishes in size when it has been ... and lodged in the cellular tissue.

... are now usually performed after the antiseptic method, ... Lister, and certainly with very remarkable success. ... Haward's care, where he put a lithotomy scoop ... to extract a body which was remarkably difficult to ... a remarkable case which occurred to myself, where there were ... cartilages, and where I put my finger and forceps freely into ... and seize them, no bad symptoms whatever ensued. ... case was lately alluded to by Sir J. Paget,[1] in which ... removed more than two hundred loose cartilages from the ... In this case however, as Mr. Smith informs me, suppuration ... became set.

... the parts as little as possible, to unite the skin- ... immediately and very carefully with suture or strapping, ... easily from the toes, and to fix it securely on a well- ... The tendency to inflammation will thus be best obviated; but ... should be at once applied; and if the inflamma- ... becomes violent, suppuration is imminent, and the case ... treated accordingly.

... rheumatic arthritis, arthritis deformans, rheumatoid arthritis, ... rheumatic gout, nodosity of the joints, is a disease which has

[1] Bradshawe Lecture at the College of Surgeons' in 1882, p. 7.

only lately been accurately described, mainly by Irish surgeons—Dr. Haygarth, Dr. Robert Adams, and Prof. R. W. Smith. The tissue originally affected (if, indeed, the disease begins in any single tissue) is difficult to determine, since we hardly ever see the disease dissected except in an advanced stage, but it is commonly believed to commence with injection of the synovial membrane,[1] which becomes distended with fluid, its vascular fringe-like processes over-developed, the joint somewhat filled with fluid, the ligaments distended and inflamed; the bursæ near the joint often share in the distension; bony deposits form in the ligamentous capsule, giving rise to the formation of the 'additamentary bones' so characteristic of this affection; the cartilages become degenerated and gradually disappear; and sometimes portions of them drop into the joint, forming one kind of loose cartilage. As the cartilage disappears the articular surface of the bone becomes polished and eburnated, the shape also of the bony surface becomes greatly changed, the cavities being much enlarged, and the articulating ends flattened out as if they had been partly melted and then squeezed out into a kind of mushroom-shape.

There is little or no tendency to suppuration, nor does ankylosis ensue, though the limb may be stiffened from the unnatural shape of the bones. In the more favourable cases, however, just the opposite issue follows; for as the joint-surfaces become polished on each other the movement becomes again free and painless.

The chief symptoms of chronic rheumatic arthritis are wearing pain in the part, alteration of its shape, and crackling on motion. This crackling is sometimes so loud as to be distinctly heard all over the room. It is due partly to the rubbing of the joint-surfaces on each other and partly to that of the additamentary bones.

The treatment of this complaint when it is fully established—i.e. when the shape of the joint-surfaces is much altered and they are exposed and crackle on each other—is never very satisfactory. All that can then be done is to palliate the pain by opium if necessary, hot douches, regulated pressure and support to the joint. But in the early stage the general treatment of rheumatism carefully carried out, and particularly residence in genial climates, and the persevering use of hot springs, may do much to avert the occurrence of the more profound and incurable changes in the bones and ligaments.

In a very few cases excision of the affected joint has been practised. Thus Dr. Humphry excised the condyle of the jaw,[2] and the head of the femur has been excised on account of chronic rheumatic arthritis at an unusually advanced age, and with alleged success. Such operations, however, can seldom be advisable, since the disease is a constitutional one, and therefore liable to present itself anew in another joint; nor is the suffering which it occasions sufficient, as a rule, to justify so dangerous an operation.

It is now universally admitted that most of the cases which have been published as 'partial dislocations,' especially of the shoulder, and as 'fractures with ligamentous union' of processes in the neighbourhood of joints, such as the acromion, were really instances of chronic rheumatic arthritis accompanied by changes in the shape and position of the joint-surfaces, by erosion and unnatural adhesion of the tendons near the heads of the bones, and by the formation of the additamentary bones, which are characteristic of this

[1] Mr. Barker, however, believes that the cartilages are in most cases affected before the synovial membrane, ('Syst. of Surg.' 3rd ed. vol. ii. pp. 344, 5).

[2] 'On the Human Skeleton,' p. 306.

able—there is often a very large deposit of bone around the old joint, and the shape and size of the ankylosed articular ends have been much altered. It may, therefore, be impossible in such cases to execute any section really deserving of the title subcutaneous, and the operation approaches in gravity and in extent to that of excision, and is liable, like excision, to be followed by renewed disease in the divided surfaces, by exhausting suppuration or by pyæmia.

I have no doubt, however, as to the applicability of the operation in cases where the ankylosis, being bony and in a vicious position, is not accompanied by great shortening of the neck of the bone, or any evidence of new bony deposit around. In such cases, if it be necessary to perform any operation, that devised by Mr. Gant is to be preferred—viz. to divide the femur just below the small trochanter, either with the saw or chisel. It need hardly be said that the earlier in life these operations are done, the more likelihood there is of success.

Hysterical and neuralgic affections.

Neuralgia and hysterical affections of joints, though they are not identical, yet are hard to separate from each other in practice. They are both characterised by pain which is out of all proportion to the evidence of actual change of structure, though there is in some cases some amount of swelling or puffiness around the joint, testifying to the presence of a certain degree of increased vascular action, which, however, is rather the consequence than the cause of the pain. In many cases this neuralgic affection is only one of the symptoms of general hysteria as testified by the other ordinary phenomena of that state, but in other cases there is no such general affection. True neuralgia is periodic, and is usually connected with some disturbance of general health or digestion. It must be treated, as in other parts, by antiperiodics, as quinine, arsenic, or hydrochlorate of ammonia in full doses, and especially by attention to the general health and the condition of the bowels, and by free exercise of the part.

The distinction between hysterical affection of a joint and organic disease is made chiefly by noticing the disproportion between the pain and the evidence of local lesions,[1] by the varying and inconsistent nature of the symptoms, and by examination under chloroform, which is often perfectly decisive, as it is also in voluntary imposition. It is strange in these cases to see how motion, which has seemed almost impossible while the patient was conscious, becomes at once completely natural when anæsthesia is obtained, and the perfectly smooth and natural condition of the articular surfaces testifies to the absence of all serious disease.

The diagnosis is, however, most difficult in practice, though its principles when stated in the above summary manner appear to be easy. A careful perusal of Sir J. Paget's lectures on this topic will show that there is no symptom of organic disease of a joint which may not be imitated by 'nervous mimicry' as he calls it—the lameness, the permanent loss of use, complete stiffness, wearing pain, even wasting of the muscles around the joint:[2] and

[1] Sir J. Paget dwells especially on the importance of the local temperature. In inflammatory affections, as synovitis, the heat of the joint is perceptibly increased, as felt by the hand laid over it, and this is not the case in nervous disorders. This test, however, is only applicable to the superficial joints.—Paget's 'Clinical Lectures,' p. 215.

[2] Not, however, the acute atrophy of serious disease. Mr. Barker remarks on this head, 'That rapid loss of tissue observed about a joint truly diseased is never seen here. Disease (if the other limb be still used) may produce leanness on the painful side, as compared with the opposite; prolonged and firm bandaging may do the same, or the wearing of elastic cover-

the matter becomes still further complicated when we reflect that on the one hand a patient most obviously hysterical may, nevertheless, have articular disease, and that on the other a patient may be suffering from nervous disease who displays no trace whatever of hysteria. Hence Sir J. Paget dwells forcibly on the necessity of commencing the investigation of the case with the local symptoms and appearances, and giving to the latter far greater weight in diagnosis than to the general aspect and history of the patient. But it is wise not to be in a hurry, and only to form and announce a positive opinion after careful and repeated examination and observation.

The treatment of these affections is spoken of on p. 371.

The above observations on the general pathology of joint-diseases are intended to be applicable to all joints in the body, though they are chiefly drawn from the phenomena of the diseases of the knee. We must now speak more particularly, though very shortly, of the diseases of some of the other joints.

Disease of the hip.

The disease of the hip (*Morbus Coxarius*), which is so common in the poor weakly children of our large cities, and which is seen occasionally also in children who are more fortunately circumstanced, is often denominated *strumous* disease. But I should like (in accordance with the observations made above, p. 456), to commence its description by protesting against the use of a term which includes a theory that is not only unproved, but, as I contend, disproved by the result of numerous cases. It would indeed be absurd to deny that strumous children often suffer from hip-disease, that hip-disease is often associated with pulmonary consumption in the family or in the person affected, or that it is sometimes, though more rarely, accompanied by other strumous or scrofulous affections. But I think it would be an equally gross error to deny that it often occurs, just as disease of any other joint does, from local injury or exposure to cold; that it is susceptible of complete cure, without any constitutional affection being left behind it, or any tendency to disease in any other part of the body; and that at even the most advanced stage it may in appropriate cases be extirpated by surgical operation with just the same prospect of definite cure as after excision of any other joint. In fact, each case must be judged on its own merits—there are strumous cases of morbus coxarius and cases not strumous, and their successful treatment depends in a great measure on their diagnosis.

Stage of inflammation.

The symptoms of disease of the hip are generally divided into three stages: 1. The first, or *inflammatory* stage, is characterised by starting pain at night, by pain in the knee, limping, and wasting of the muscles. Sometimes one of these symptoms, sometimes another, is the first which is noticed. Perhaps of all other symptoms the loss of motion of the joint is that which is most convincing. On laying the child down and rotating[1] or flexing first the sound and then the affected limb, the contrast between the easy and even movement of the former and the stiff, painful, imperfect motion of the latter is very striking. There is occasionally, but not often, some fulness of the hip, as if from effusion into the capsule of the joint, and some heat of the parts. In some cases fulness and possibly tenderness to pressure may be made out around

but the loss of bulk is usually trifling, and in clear contrast to what might be expected were disease present in a degree equal to the patient's belief, or in correspondence with other symptoms.'—'Syst. of Surg.' 3rd ed. vol. ii. p. 363.

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the trochanter major. The limb very commonly appears to be lengthened, but this is found on measurement to be only apparent, and dependent on the position of the pelvis, which is adducted—that is, drawn down on the affected side—so that the spine of the ilium is lower on that than on the sound side. The opposite side of the pelvis, however, is often dropped, and the affected limb is apparently shortened, though no real change in its length has taken place.[1]

[1] What the cause of the various phenomena of hip-disease may be is not easy to determine. The wasting of the muscles is a most striking phenomenon, and is present often to a considerable extent before the diagnosis of hip-disease has been formed; though not, therefore, before the disease has commenced (see Nunn, in 'Path. Trans.' vol. xviii. p. 217); and it affects, as Mr. Nunn has pointed out, not the muscles of the hip only—though chiefly these—but also the whole limb. Sir J. Paget ('Clin. Lectures,' p. 208) has called attention to the great extent of wasting which goes on in these and other acute diseases of the joints, and has shown that it is too rapid to be accounted for entirely by disuse; though disuse, of course, plays a part in it. The causes also of the apparent lengthening and shortening of the limb are the subjects of much difference of opinion. It is clear that the lengthening depends on position only. The two main theories which are now adduced as reasons for this position are that of MM. Martin and Collineau, which refers it to the disposition of the fibres of the capsule, and that of Mr. Barwell, which attributes it solely to a contracted condition of the abductor muscles of the thigh. In the view of the French authors there are different kinds of hip-disease, and that kind which commences in inflammation of the articular capsule ('capsular coxalgia,' as they style it) is accompanied at first by a relaxed condition of the capsular ligament, which produces abduction and rotation outwards, or rather necessarily involves that position, in consequence of the anatomical disposition of the fibres of the capsule, and the muscles accordingly place the limb in abduction. This position of the femur induces, secondarily, an adducted position, or dropping, of the pelvis in order to maintain equilibrium in the erect position. After a time the inflammatory elongation of the capsule is succeeded by induration and contraction, involving a change from the elongated to the apparently shortened condition of the limb. Thus are explained the many cases in which elongation is the primary, and shortening the secondary symptom. Shortening adduction and rotation inwards of the femur are also produced, according to these authors, by an inflamed condition of the acetabulum and head of the femur, and by the muscular contractions provoked by such inflammation. This species of hip-disease ('coxalgic osteitis') may occur either primarily (and thus are explained those cases in which shortening occurs without previous elongation), or it may follow on the 'capsular coxalgia,' which produces elongation. The real shortening everybody allows to be produced by changes in the size and relation of the acetabulum and upper end of the femur. Mr. Barwell attributes the lengthening to a spasmodic condition of the abductor muscles, which he says always accompanies the distension of the capsule; and he appears to believe that such distension is always relieved by the bursting of the capsule before the second stage—that of adduction or shortening—comes on. If I have rightly understood Mr. Barwell's theory, it hardly explains those cases in which shortening is not preceded by elongation, nor those more numerous cases in which there is decidedly no trace of any such perforation of the capsule as Mr. Barwell speaks of. But both theories agree in this, that they refer both positions to the preponderating and spasmodic action of certain sets of muscles; and without professing myself satisfied as to the correctness of the details of either theory, I fully agree in the main practical inference to which they point, viz. that the early symptoms of hip-disease are in a great measure muscular, and can only be treated successfully by measures directed to the relief of muscular contraction, i.e. by mechanical extension.—Holmes's 'Surgical Treatment of Children's Diseases,' p. 443. Mr. Marsh observes that although flexion and abduction, often combined with slight external rotation, is the usual position of the limb in the early stages of the disease, yet any set of muscles around the joint may be in this condition of reflex irritation, and he gives an instance in which the limb was hyper-extended.—'Brit. Med. Journ.' July 14, 1877. Mr. E. Owen, in an interesting paper in the 'Brit. Med. Journ.' Dec. 14, 1878 (p. 873), takes a slightly different view of the matter, attributing the abduction and flexion of the limb in a great measure to the distension of the capsule with fluid, the effect of which he shows by an ingenious experiment on the dead subject. The same view is adopted by Mr. Barker.—'Syst. of Surg.' 3rd ed. vol. ii. p. 364. But the difficulty in believing that the position of the limb in hip-disease is due solely to the distension of the capsule, lies in the fact that in very many cases (I think in the great majority) there is no trace of any such distension. Besides, the distended state of the capsule would only account for one position of the limb, while in hip-disease, although that position is the most common, many other positions are occasionally found.

the matter becomes still further complicated when we reflect that on the one hand a patient most obviously hysterical may, nevertheless, have articular disease, and that on the other a patient may be suffering from nervous disease who displays no trace whatever of hysteria. Hence Sir J. Paget dwells forcibly on the necessity of commencing the investigation of the case with the local symptoms and appearances, and giving to the latter far greater weight in diagnosis than to the general aspect and history of the patient. But it is wise not to be in a hurry, and only to form and announce a positive opinion after careful and repeated examination and observation.

The treatment of these affections is spoken of on p. 371.

The above observations on the general pathology of joint-diseases are intended to be applicable to all joints in the body, though they are chiefly drawn from the phenomena of the diseases of the knee. We must now speak more particularly, though very shortly, of the diseases of some of the other joints.

Disease of the hip.

The disease of the hip (*Morbus Coxarius*), which is so common in the poor weakly children of our large cities, and which is seen occasionally also in children who are more fortunately circumstanced, is often denominated *strumous* disease. But I should like (in accordance with the observations made above, p. 456), to commence its description by protesting against the use of a term which includes a theory that is not only unproved, but, as I contend, disproved by the result of numerous cases. It would indeed be absurd to deny that strumous children often suffer from hip-disease, that hip-disease is often associated with pulmonary consumption in the family or in the person affected, or that it is sometimes, though more rarely, accompanied by other strumous or scrofulous affections. But I think it would be an equally gross error to deny that it often occurs, just as disease of any other joint does, from local injury or exposure to cold; that it is susceptible of complete cure, without any constitutional affection being left behind it, or any tendency to disease in any other part of the body; and that at even the most advanced stage it may in appropriate cases be extirpated by surgical operation with just the same prospect of definite cure as after excision of any other joint. In fact, each case must be judged on its own merits—there are strumous cases of morbus coxarius and cases not strumous, and their successful treatment depends in a great measure on their diagnosis.

Stage of inflammation.

The symptoms of disease of the hip are generally divided into three stages: 1. The first, or *inflammatory* stage, is characterised by starting pain at night, by pain in the knee, limping, and wasting of the muscles. Sometimes one of these symptoms, sometimes another, is the first which is noticed. Perhaps of all other symptoms the loss of motion of the joint is that which is most convincing. On laying the child down and rotating[1] or flexing first the sound and then the affected limb, the contrast between the easy and even movement of the former and the stiff, painful, imperfect motion of the latter is very striking. There is occasionally, but not often, some fulness of the hip, as if from effusion into the capsule of the joint, and some heat of the parts. In some cases fulness and possibly tenderness to pressure may be made out around

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exposed; and as the suppuration progresses the ligaments are inflamed and softened, so that the interarticular ligaments are apt to give way, and the capsule to yield to the pressure of the bone, now displaced by the muscular action, and so dislocation will ensue if great care is not taken.

Finally, the occurrence of acute suppuration in the joint needs no explanation, since pus is furnished not merely by the cartilage but in far greater quantity by the granulations on the inflamed synovial membrane and bone.

The treatment of this acute inflammatory disease is at the present time less active than it used to be; but still though we have, perhaps, been wise in giving up the excessive local bleeding and counter-irritation and the free administration of mercury which was in vogue some years ago, we have abundant opportunities of testing the value of more moderate antiphlogistics and counter-irritants in the form of the free application of leeches, blistering, or issues. The strictest local rest should be at the same time enforced. If the joint is too irritable to bear a splint it should be supported on all sides by some soft substance, such as a junk well padded with tow or cotton-wool sufficiently to prevent any serious displacement; or if such displacement has taken place before the case is seen the limb should be at once put into as good a position as possible under anæsthesia. The free administration of opium to such an extent as will relieve the pain is necessary. In robust persons with high inflammation I have often seen great improvement from a course of mercury rapidly administered; and although conscious of the evils which follow the indiscriminate use of mercury, in such cases I venture to recommend it.

The necessity for amputation arises when the symptoms of abscess in the joint are plain, and when in the surgeon's judgment the patient has not strength to survive the opening of the abscess—as to which enough has been said above (p. 453).

Excision is not successful, and should not be practised in these acute conditions of inflammation in the lower limb; but in the upper limb there is no such objection, and I have more than once excised the elbow with success in the acute stage of the disease.

Other degenerations of cartilages.

There are other degenerations of the articular cartilages, as hypertrophy, atrophy, fibrous, fatty, and calcareous degeneration; but they produce no known symptoms during life, and I must therefore refer the reader to works on pathological anatomy for their elucidation. The extensive changes thus found in the cartilages, with no symptoms during life, strengthen the opinion that in the destructive disease called 'ulceration of the cartilages' the condition of the latter is really a subordinate feature.

Loose cartilages.

Loose 'cartilages,' or, as some prefer to call them, 'loose bodies' in the joints, are sometimes numerous. They are seen almost but not quite exclusively in the knee-joint. Rare cases are recorded and preserved in the elbow and other joints, but they are rather surgical curiosities than matters of practical interest. The following will, therefore, apply to the disease as found in the knee.

Many of them are not really cartilaginous—at least, if there is any true cartilage in them it is in such small quantity as to escape even a careful examination. The bulk of the body consists usually of fibrous tissue, in which perhaps a small cartilaginous nodule may be found, and the cartilage is sometimes extensively or almost entirely calcified. In other cases, however, they have been found cartilaginous throughout, and in some true bone forms a part or

Corresponding to this altered position of the pelvis, a compensating curve must be formed in the lumbar spine, and can often be detected by careful examination.

The pathological anatomy of the early stage of hip-disease is not easy to determine, and it appears to me probable that the disease commences at one time in the ends of the bones, at another in the synovial membrane or in the ligaments. On this head I would refer to the observations which I have made in a work on the 'Surgical Treatment of Children's Diseases,' 2nd ed. pp. 435 et seq., in which I endeavour to prove that in most cases the visible results of inflammation are first seen in or about the ligamentous capsule and the ligamentum teres, though some cases probably commence as common synovitis, and others with low inflammation of the bones.

Stage of abscess.

2. The second stage is that of *abscess*, which is not, however, necessarily connected with disease of the bones, nor always situated in the cavity of the joint. Very frequently it is external to the articulation, and the bones are unaffected. Examination under chloroform will settle this point by revealing true crepitus when the bones are diseased, or the grating sensation of roughened cartilage when the mischief is less deep-seated.

Stage of real shortening.

3. The third stage is that of real *shortening*.[1] This shortening is produced by caries and absorption of the head and neck of the femur and of the acetabulum. The upper end of the femur is in some cases so disintegrated that only a small irregular projection may remain above the trochanter, and in most cases the head is found to be diminished in size, and nearer the trochanter than natural. The acetabulum is often greatly enlarged, and not unfrequently perforated by ulceration. There is abscess, which has generally burst externally, either in the thigh, the pelvis, or both. In consequence of this change of shape of the bones there is a displacement, commonly called dislocation, but which differs from dislocation in the very important particular that the ulcerated articular surfaces are not separated from each other, but remain in mutual contact, and therefore irritate each other. To this rule there are, of course, exceptions, in which the head of the femur has entirely quitted the acetabulum; but, as far as I have seen, they are very rare. In some still rarer cases the capsule is so stretched and the ligaments have so far yielded that the head of the bone will quit the acetabulum and return again into it



Fig. 218. Dislocation of the hip from disease. A preparation, Ser. iii. No. 86, in the Museum of St. George's Hospital.—'Syst. of Surg.' 3rd ed. vol. ii. p. 372.

[1] Other writers, following Ford, make a different classification, viz. first stage, pain, &c.; second stage, apparent lengthening; third stage, shortening. It is extremely difficult to make any division into stages which is not open to many objections and liable to frequent exceptions. The one in the text seems to me more practical and more natural than Ford's, as it fixes the surgeon's mind on two of the most important events in the disease, suppuration and real shortening.

the loose body may at length adhere in that position. It will, of course, be understood that the movements of the joint are restrained meanwhile by a firm bandage or kneecap. Attempts have been made to fix the loose body by driving a fine needle or silver suture through it, but not, I believe, with encouraging results. But in most cases, where the joint is otherwise healthy and the patient is obliged to use it, the removal of the loose cartilage becomes necessary, and this is effected in one of two ways. In both the body must be securely held by the surgeon's left forefinger and thumb placed under it, or if it is very loose it may be steadied by means of a needle. Then in the *direct* method of extraction the surgeon cuts down on the loose substance and gently squeezes it out of the wound, following it with his finger and thumb, so as, if possible, to prevent the escape of synovia from the joint. And in order that the wound into the joint may be less direct it is well to have previously drawn the skin to one side over the loose cartilage, so that when the parts return to their proper position the skin-wound no longer corresponds to the opening in the joint. In the *subcutaneous* method (which is believed to be more safe, though the evidence on that point is not conclusive) a tendon-knife is passed down to the surface of the loose body and a bed or cavity formed for it in the track of the knife: an opening is then made into the capsule of the joint, through which the cartilage can be squeezed into the subcutaneous tissue. There it is left, either for life, or, if it causes any inconvenience, until the opening in the joint has long healed, when it is cut down upon and extracted. In some cases difficulty is experienced in squeezing the body out of the joint, in consequence of its being not absolutely loose but pedunculated. An interesting instance is reported by Sir W. McCormac ('St. Thomas's Hospital Reports,' New Ser. vol. v. 1874) in which he finally succeeded by vigorous pressure with his thumbs in rupturing the pedicle and pushing the loose body out—and the same case also illustrates another point in the surgery of loose cartilage—viz. that the loose body often diminishes in size when it has been squeezed out of the joint and lodged in the cellular tissue.

These operations are now usually performed after the antiseptic method, as recommended by Prof. Lister, and certainly with very remarkable success. Thus in a case under Mr. Haward's care, where he put a lithotomy scoop into the joint in order to extract a body which was remarkably difficult to seize, and in a remarkable case which occurred to myself, where there were seven large loose cartilages, and where I put my finger and forceps freely into the joint in order to find and seize them, no bad symptoms whatever ensued. A still more remarkable case was lately alluded to by Sir J. Paget,[1] in which Mr. T. Smith removed more than two hundred loose cartilages from the knee-joint. In that case however, as Mr. Smith informs me, suppuration ensued, and the joint became stiff.

It is essential to disturb the parts as little as possible, to unite the skin-wound or puncture immediately and very carefully with suture or strapping, to bandage the limb evenly from the toes, and to fix it securely on a well-fitting splint. The tendency to inflammation will thus be best obviated; but if the knee does inflame cold should be at once applied; and if the inflammation increases and becomes violent, suppuration is imminent, and the case must be treated accordingly.

Chronic rheumatic arthritis.

Chronic rheumatic arthritis, arthritis deformans, rheumatoid arthritis, osteo-arthritis, rheumatic gout, nodosity of the joints, is a disease which has

[1] 'Bradshawe Lecture at the College of Surgeons' in 1882, p. 7.

only lately been accurately described, mainly by Irish surgeons—Dr. Haygarth, Dr. Robert Adams, and Prof. R. W. Smith. The tissue originally affected (if, indeed, the disease begins in any single tissue) is difficult to determine, since we hardly ever see the disease dissected except in an advanced stage, but it is commonly believed to commence with injection of the synovial membrane,[1] which becomes distended with fluid, its vascular fringe-like processes over-developed, the joint somewhat filled with fluid, the ligaments distended and inflamed; the bursæ near the joint often share in the distension; bony deposits form in the ligamentous capsule, giving rise to the formation of the 'additamentary bones' so characteristic of this affection; the cartilages become degenerated and gradually disappear; and sometimes portions of them drop into the joint, forming one kind of loose cartilage. As the cartilage disappears the articular surface of the bone becomes polished and eburnated, the shape also of the bony surface becomes greatly changed, the cavities being much enlarged, and the articulating ends flattened out as if they had been partly melted and then squeezed out into a kind of mushroom-shape.

There is little or no tendency to suppuration, nor does ankylosis ensue, though the limb may be stiffened from the unnatural shape of the bones. In the more favourable cases, however, just the opposite issue follows; for as the joint-surfaces become polished on each other the movement becomes again free and painless.

The chief symptoms of chronic rheumatic arthritis are wearing pain in the part, alteration of its shape, and crackling on motion. This crackling is sometimes so loud as to be distinctly heard all over the room. It is due partly to the rubbing of the joint-surfaces on each other and partly to that of the additamentary bones.

The treatment of this complaint when it is fully established—i.e. when the shape of the joint-surfaces is much altered and they are exposed and crackle on each other—is never very satisfactory. All that can then be done is to palliate the pain by opium if necessary, hot douches, regulated pressure and support to the joint. But in the early stage the general treatment of rheumatism carefully carried out, and particularly residence in genial climates, and the persevering use of hot springs, may do much to avert the occurrence of the more profound and incurable changes in the bones and ligaments.

In a very few cases excision of the affected joint has been practised. Thus Dr. Humphry excised the condyle of the jaw,[2] and the head of the femur has been excised on account of chronic rheumatic arthritis at an unusually advanced age, and with alleged success. Such operations, however, can seldom be advisable, since the disease is a constitutional one, and therefore liable to present itself anew in another joint; nor is the suffering which it occasions sufficient, as a rule, to justify so dangerous an operation.

It is now universally admitted that most of the cases which have been published as 'partial dislocations,' especially of the shoulder, and as 'fractures with ligamentous union' of processes in the neighbourhood of joints, such as the acromion, were really instances of chronic rheumatic arthritis accompanied by changes in the shape and position of the joint-surfaces, by erosion and unnatural adhesion of the tendons near the heads of the bones, and by the formation of the additamentary bones, which are characteristic of this

[1] Mr. Barker, however, believes that the cartilages are in most cases affected before the synovial membrane, ('Syst. of Surg.' 3rd ed. vol. ii. pp. 344, 5).

[2] 'On the Human Skeleton,' p. 306.

affection. (See Dr. R. Adams's work on 'Rheumatic Gout,' 2nd ed. pp. 118 and sqq.; and his plate iii. figs. 1, 2.)

Chronic joint disease from affections of the central nervous system.

A very interesting discovery has lately been made by M. Charcot, viz. that a disease very similar to, if not identical with, chronic rheumatic arthritis is developed, not as a consequence of rheumatism, but from degeneration of the centre from which the joint is supplied with nervous influence, and especially accompanies locomotor ataxy. I would refer the reader to the section headed 'On Arthropathies of Cerebral or Spinal Origin,' in Charcot's 'Lectures on Diseases of the Nervous System,' translated for the New Syd. Soc. The specimens figured and described seem to want the additamentary bones which are so striking a feature in rheumatic arthritis. Treatment can be only palliative.

Ankylosis.

Ankylosis, or stiffening of joints, is of three kinds. In the first, which is denominated the *extra-articular*, it depends on fibrous adhesions in the soft parts external to the bones, such as take place in limbs which have been long kept in constrained positions, as in the treatment of fracture. In the second, or *fibrous* (false) ankylosis, the joint-surfaces are united by bands which pass from one articular cartilage to the other, such as have been above described as forming after ulceration of the cartilages or after synovitis. In the third, or *bony* (true) ankylosis, the articular cartilages having been removed, the bones, exposed and ulcerated, unite, as in compound fracture, by granulations, in which ossification occurs, until at length the whole becomes one solid mass of bone.

The diagnosis between bony and fibrous ankylosis can usually be made under chloroform, for in the fibrous ankylosis some amount of passive motion is always possible, while in the bony there is none. And again, in bony ankylosis the muscles around the joint waste to an extent which is never seen in the fibrous. The diagnosis between the fibrous and the extra-articular ankylosis can be made in part by the history, and in part by the result of examination under chloroform. In fibrous ankylosis movement is fettered by a definite band or bands. It is, therefore, perfectly unopposed until those bands are put on the stretch, when it is abruptly checked. In the extra-articular it is a generally stiffened condition of all the parts around which opposes motion.

The treatment must be determined partly by the nature of the ankylosis, and partly by the amount of inconvenience which it causes. Extra-articular adhesions can usually be got rid of by constant passive motion, oiling the part, gradually or abruptly stretching it, or applying various extending apparatus. Many instantaneous cures are effected in this and in fibrous ankylosis by sudden wrenches which break down the bands and restore motion at once. Such cures are often worked haphazard (and sometimes, also, it must be owned, with a definite purpose and knowledge) by quacks in cases neglected or given up by regular practitioners, much to the shame of the latter. Remembering the frequency of these cases, we should be cautious of insisting too long on confined positions of joints in the treatment of accident or disease; and when stiffening has taken place, and all inflammatory symptoms have subsided, a careful examination under chloroform will often detect one or more definite bands, which can be ruptured and the part at once restored to its function, gradually increasing passive and active motion being afterwards carefully insisted on.

In more extensive fibrous ankylosis there will be much more difficulty in restoring mobility. Long patience is required on the surgeon's part, and

unusual confidence on that of the patient, before the desired end can be reached, and often the adhesions will re-form time after time. Still, even if ultimately a stiff joint is left, at least its position may be improved and the limb be left useful instead of useless. Some caution is necessary in making forcible extension in such cases to avoid doing injury to neighbouring parts or fracturing the bones in childhood, or in adults when the bone is weakened by atrophy. A useful precaution is to hold the bones as near the joint as may be, and to rupture the adhesions by short movements in the way of flexion before attempting to put the limb straight by extension movements. Again, the tendons, in case of old dislocation or ankylosis in false positions, are often so contracted as to require division before the case can be successfully treated, and this must always be done some days before the attempt at extension.

Subcutaneous division of bone for ankylosis.

Bony ankylosis is one of the methods of cure in joint-disease, and it should not, therefore, be interfered with, unless the position in which it has occurred renders the limb useless. In such cases the simplest plan (and it is also the least dangerous) is to fracture the bone below the joint and put the limb straight; but this is seldom possible or safe except in childhood. Bony ankylosis of the hip has lately been treated very extensively by subcutaneous section of the femur. This operation was introduced into practice by Langenbeck and Gross [1] for the cure of angular ankylosis of the knee, but the operation on the hip was devised by Mr. W. Adams. A small incision is made with a long narrow knife across the portion of the bone to be divided—a narrow saw is introduced, and the neck of the bone sawn until it will give way and allow the limb to be put straight: or the bone is divided with a chisel and mallet. The entrance of air is to be as much as possible avoided. In many cases the operation has been very successful, and in some the motions of the limb have been to a certain extent at least preserved.[2] Some cases, however, have proved fatal from pyæmia or protracted suppuration. The difficulty lies in the selection of suitable cases. In many of those successfully operated on, it seems quite possible that equally good results could have been obtained by forcible extension, since the ankylosis was not bony.[3] In many of the cases which really require any such operation—i.e. where the change in the relative position of the bones is consider-

[1] Langenbeck's and Gross's operations on the knee are referred to in the 'New Syd. Soc.'s Retrospect,' 1867–68, p. 256. Langenbeck's, Guérin's, and other surgeons' labours in this operation will be found summarised in Mr. Adams's Pamphlet on 'Subcutaneous Division of the Neck of the Thigh-bone,' 1871. See also Dr. Little's article on 'Osteotomy' in 'Syst. of Surg.' 3rd ed. vol. iii.

[2] See a paper by Mr. Adams, 'Med.-Chir. Trans.' vol. lx. p. 1. In the table appended to this paper, Mr. Adams has omitted a case operated on by myself with a fatal result, because the operation was not truly subcutaneous. I contend, however, that many of the successful operations were in no sense subcutaneous. See also papers by Mr. Brodhurst and Mr. Croft, in 'Clin. Soc. Trans.' vol. x.

[3] A lad was under my care once in whom the hip was ankylosed after gonorrhœal rheumatism, in a very awkward posture, so as to be perfectly useless. The short time which had elapsed (not much over half a year) since the attack made it difficult to believe that the ankylosis was bony, yet attempts at passive motion under anæsthesia repeated on two occasions gave no result. It was determined to make a more forcible attempt with the assistance of my colleagues, and, if this failed, to divide the neck of the bone. The attempt seemed at first quite nugatory, and I was just selecting my instruments, when on a still more vigorous effort by some of those who were assisting me a slight crack was perceived; we therefore persevered in our efforts, and soon restored the bone to its proper position with considerable mobility. I believe that in many of the published cases the same might have been done.

able—there is often a very large deposit of bone around the old joint, and the shape and size of the ankylosed articular ends have been much altered. It may, therefore, be impossible in such cases to execute any section really deserving of the title subcutaneous, and the operation approaches in gravity and in extent to that of excision, and is liable, like excision, to be followed by renewed disease in the divided surfaces, by exhausting suppuration or by pyæmia.

I have no doubt, however, as to the applicability of the operation in cases where the ankylosis, being bony and in a vicious position, is not accompanied by great shortening of the neck of the bone, or any evidence of new bony deposit around. In such cases, if it be necessary to perform any operation, that devised by Mr. Gant is to be preferred—viz. to divide the femur just below the small trochanter, either with the saw or chisel. It need hardly be said that the earlier in life these operations are done, the more likelihood there is of success.

Hysterical and neuralgic affections.

Neuralgia and hysterical affections of joints, though they are not identical, yet are hard to separate from each other in practice. They are both characterised by pain which is out of all proportion to the evidence of actual change of structure, though there is in some cases some amount of swelling or puffiness around the joint, testifying to the presence of a certain degree of increased vascular action, which, however, is rather the consequence than the cause of the pain. In many cases this neuralgic affection is only one of the symptoms of general hysteria as testified by the other ordinary phenomena of that state, but in other cases there is no such general affection. True neuralgia is periodic, and is usually connected with some disturbance of general health or digestion. It must be treated, as in other parts, by antiperiodics, as quinine, arsenic, or hydrochlorate of ammonia in full doses, and especially by attention to the general health and the condition of the bowels, and by free exercise of the part.

The distinction between hysterical affection of a joint and organic disease is made chiefly by noticing the disproportion between the pain and the evidence of local lesions,[1] by the varying and inconsistent nature of the symptoms, and by examination under chloroform, which is often perfectly decisive, as it is also in voluntary imposition. It is strange in these cases to see how motion, which has seemed almost impossible while the patient was conscious, becomes at once completely natural when anæsthesia is obtained, and the perfectly smooth and natural condition of the articular surfaces testifies to the absence of all serious disease.

The diagnosis is, however, most difficult in practice, though its principles when stated in the above summary manner appear to be easy. A careful perusal of Sir J. Paget's lectures on this topic will show that there is no symptom of organic disease of a joint which may not be imitated by 'nervous mimicry' as he calls it—the lameness, the permanent loss of use, complete stiffness, wearing pain, even wasting of the muscles around the joint:[2] and

[1] Sir J. Paget dwells especially on the importance of the local temperature. In inflammatory affections, as synovitis, the heat of the joint is perceptibly increased, as felt by the hand laid over it, and this is not the case in nervous disorders. This test, however, is only applicable to the superficial joints.—Paget's 'Clinical Lectures,' p. 215.

[2] Not, however, the acute atrophy of serious disease. Mr. Barker remarks on this head, 'That rapid loss of tissue observed about a joint truly diseased is never seen here. Disease (if the other limb be still used) may produce leanness on the painful side, as compared with the opposite; prolonged and firm bandaging may do the same, or the wearing of elastic cover-

the matter becomes still further complicated when we reflect that on the one hand a patient most obviously hysterical may, nevertheless, have articular disease, and that on the other a patient may be suffering from nervous disease who displays no trace whatever of hysteria. Hence Sir J. Paget dwells forcibly on the necessity of commencing the investigation of the case with the local symptoms and appearances, and giving to the latter far greater weight in diagnosis than to the general aspect and history of the patient. But it is wise not to be in a hurry, and only to form and announce a positive opinion after careful and repeated examination and observation.

The treatment of these affections is spoken of on p. 371.

The above observations on the general pathology of joint-diseases are intended to be applicable to all joints in the body, though they are chiefly drawn from the phenomena of the diseases of the knee. We must now speak more particularly, though very shortly, of the diseases of some of the other joints.

Disease of the hip.

The disease of the hip (*Morbus Coxarius*), which is so common in the poor weakly children of our large cities, and which is seen occasionally also in children who are more fortunately circumstanced, is often denominated *strumous* disease. But I should like (in accordance with the observations made above, p. 456), to commence its description by protesting against the use of a term which includes a theory that is not only unproved, but, as I contend, disproved by the result of numerous cases. It would indeed be absurd to deny that strumous children often suffer from hip-disease, that hip-disease is often associated with pulmonary consumption in the family or in the person affected, or that it is sometimes, though more rarely, accompanied by other strumous or scrofulous affections. But I think it would be an equally gross error to deny that it often occurs, just as disease of any other joint does, from local injury or exposure to cold; that it is susceptible of complete cure, without any constitutional affection being left behind it, or any tendency to disease in any other part of the body; and that at even the most advanced stage it may in appropriate cases be extirpated by surgical operation with just the same prospect of definite cure as after excision of any other joint. In fact, each case must be judged on its own merits—there are strumous cases of morbus coxarius and cases not strumous, and their successful treatment depends in a great measure on their diagnosis.

Stage of inflammation.

The symptoms of disease of the hip are generally divided into three stages: 1. The first, or *inflammatory* stage, is characterised by starting pain at night, by pain in the knee, limping, and wasting of the muscles. Sometimes one of these symptoms, sometimes another, is the first which is noticed. Perhaps of all other symptoms the loss of motion of the joint is that which is most convincing. On laying the child down and rotating[1] or flexing first the sound and then the affected limb, the contrast between the easy and even movement of the former and the stiff, painful, imperfect motion of the latter is very striking. There is occasionally, but not often, some fulness of the hip, as if from effusion into the capsule of the joint, and some heat of the parts. In some cases fulness and possibly tenderness to pressure may be made out around

ings: but the loss of bulk is usually trifling, and in clear contrast to what might be expected were disease present in a degree equal to the patient's belief, or in correspondence to other symptoms.'—'Syst. of Surg.' 3rd ed. vol. ii. p. 363.

[1] Both forms of movement must be tested, and carefully compared. In Mr. Marsh's opinion, 'rotation is a better test of the state of the joint than flexion or extension.'

the trochanter major. The limb very commonly appears to be lengthened, but this is found on measurement to be only apparent, and dependent on the position of the pelvis, which is adducted—that is, drawn down on the affected side—so that the spine of the ilium is lower on that than on the sound side. The opposite side of the pelvis, however, is often dropped, and the affected limb is apparently shortened, though no real change in its length has taken place.[1]

[1] What the cause of the various phenomena of hip-disease may be is not easy to determine. The wasting of the muscles is a most striking phenomenon, and is present often to a considerable extent before the diagnosis of hip-disease has been formed; though not, therefore, before the disease has commenced (see Nunn, in 'Path. Trans.' vol. xviii. p. 217); and it affects, as Mr. Nunn has pointed out, not the muscles of the hip only—though chiefly these—but also the whole limb. Sir J. Paget ('Clin. Lectures,' p. 208) has called attention to the great extent of wasting which goes on in these and other acute diseases of the joints, and has shown that it is too rapid to be accounted for entirely by disuse; though disuse, of course, plays a part in it. The causes also of the apparent lengthening and shortening of the limb are the subjects of much difference of opinion. It is clear that the lengthening depends on position only. The two main theories which are now adduced as reasons for this position are that of MM. Martin and Collineau, which refers it to the disposition of the fibres of the capsule, and that of Mr. Barwell, which attributes it solely to a contracted condition of the abductor muscles of the thigh. In the view of the French authors there are different kinds of hip-disease, and that kind which commences in inflammation of the articular capsule ('capsular coxalgia,' as they style it) is accompanied at first by a relaxed condition of the capsular ligament, which produces abduction and rotation outwards, or rather necessarily involves that position, in consequence of the anatomical disposition of the fibres of the capsule, and the muscles accordingly place the limb in abduction. This position of the femur induces, secondarily, an adducted position, or dropping, of the pelvis in order to maintain equilibrium in the erect position. After a time the inflammatory elongation of the capsule is succeeded by induration and contraction, involving a change from the elongated to the apparently shortened condition of the limb. Thus are explained the many cases in which elongation is the primary, and shortening the secondary symptom. Shortening adduction and rotation inwards of the femur are also produced, according to these authors, by an inflamed condition of the acetabulum and head of the femur, and by the muscular contractions provoked by such inflammation. This species of hip-disease ('coxalgic osteitis') may occur either primarily (and thus are explained those cases in which shortening occurs without previous elongation), or it may follow on the 'capsular coxalgia,' which produces elongation. The real shortening everybody allows to be produced by changes in the size and relation of the acetabulum and upper end of the femur. Mr. Barwell attributes the lengthening to a spasmodic condition of the abductor muscles, which he says always accompanies the distension of the capsule; and he appears to believe that such distension is always relieved by the bursting of the capsule before the second stage—that of adduction or shortening—comes on. If I have rightly understood Mr. Barwell's theory, it hardly explains those cases in which shortening is not preceded by elongation, nor those more numerous cases in which there is decidedly no trace of any such perforation of the capsule as Mr. Barwell speaks of. But both theories agree in this, that they refer both positions to the preponderating and spasmodic action of certain sets of muscles; and without professing myself satisfied as to the correctness of the details of either theory, I fully agree in the main practical inference to which they point, viz. that the early symptoms of hip-disease are in a great measure muscular, and can only be treated successfully by measures directed to the relief of muscular contraction, i.e. by mechanical extension.—Holmes's 'Surgical Treatment of Children's Diseases,' p. 443. Mr. Marsh observes that although flexion and abduction, often combined with slight external rotation, is the usual position of the limb in the early stages of the disease, yet any set of muscles around the joint may be in this condition of reflex irritation, and he gives an instance in which the limb was hyper-extended.—'Brit. Med. Journ.' July 14, 1877. Mr. E. Owen, in an interesting paper in the 'Brit. Med. Journ.' Dec. 14, 1878 (p. 873), takes a slightly different view of the matter, attributing the abduction and flexion of the limb in a great measure to the distension of the capsule with fluid, the effect of which he shows by an ingenious experiment on the dead subject. The same view is adopted by Mr. Barker.—'Syst. of Surg.' 3rd ed. vol. ii. p. 364. But the difficulty in believing that the position of the limb in hip-disease is due solely to the distension of the capsule, lies in the fact that in very many cases (I think in the great majority) there is no trace of any such distension. Besides, the distended state of the capsule would only account for one position of the limb, while in hip-disease, although that position is the most common, many other positions are occasionally found.

Corresponding to this altered position of the pelvis, a compensating curve must be formed in the lumbar spine, and can often be detected by careful examination.

The pathological anatomy of the early stage of hip-disease is not easy to determine, and it appears to me probable that the disease commences at one time in the ends of the bones, at another in the synovial membrane or in the ligaments. On this head I would refer to the observations which I have made in a work on the 'Surgical Treatment of Children's Diseases,' 2nd ed. pp. 435 et seq., in which I endeavour to prove that in most cases the visible results of inflammation are first seen in or about the ligamentous capsule and the ligamentum teres, though some cases probably commence as common synovitis, and others with low inflammation of the bones.

Stage of abscess.

2. The second stage is that of *abscess*, which is not, however, necessarily connected with disease of the bones, nor always situated in the cavity of the joint. Very frequently it is external to the articulation, and the bones are unaffected. Examination under chloroform will settle this point by revealing true crepitus when the bones are diseased, or the grating sensation of roughened cartilage when the mischief is less deep-seated.

Stage of real shortening.

3. The third stage is that of real *shortening*.[1] This shortening is produced by caries and absorption of the head and neck of the femur and of the acetabulum. The upper end of the femur is in some cases so disintegrated that only a small irregular projection may remain above the trochanter, and in most cases the head is found to be diminished in size, and nearer the trochanter than natural. The acetabulum is often greatly enlarged, and not unfrequently perforated by ulceration. There is abscess, which has generally burst externally, either in the thigh, the pelvis, or both. In consequence of this change of shape of the bones there is a displacement, commonly called dislocation, but which differs from dislocation in the very important particular that the ulcerated articular surfaces are not separated from each other, but remain in mutual contact, and therefore irritate each other. To this rule there are, of course, exceptions, in which the head of the femur has entirely quitted the acetabulum; but, as far as I have seen, they are very rare. In some still rarer cases the capsule is so stretched and the ligaments have so far yielded that the head of the bone will quit the acetabulum and return again into it

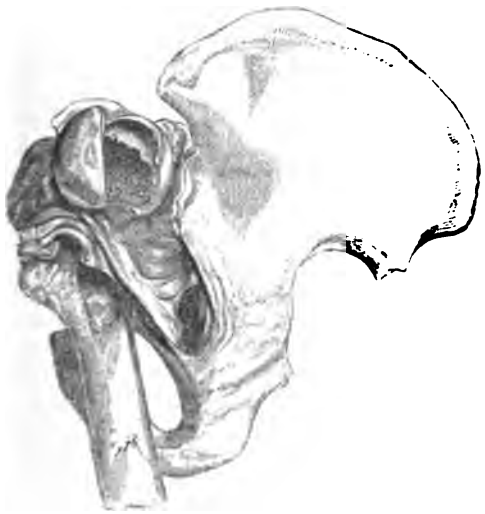


FIG. 218. Dislocation of the hip from disease. A preparation, Ser. iii. No. 86, in the Museum of St. George's Hospital.—'Syst. of Surg.' 3rd ed. vol. ii. p. 372.

[1] Other writers, following Ford, make a different classification, viz. first stage, pain, &c.; second stage, apparent lengthening; third stage, shortening. It is extremely difficult to make any division into stages which is not open to many objections and liable to frequent exceptions. The one in the text seems to me more practical and more natural than Ford's, as it fixes the surgeon's mind on two of the most important events in the disease, suppuration and real shortening.

on manipulation with perfect ease. I have referred to such a case in the work above quoted (p. 438), in which the patient had not suffered from any congenital affection, where there had been no formation of matter and there was no grating of the bones on each other. But by very slight manipulation the head of the femur could be dislocated on to the dorsum ilii, as proved by the sensation of the head slipping out of the socket, which could be plainly perceived; and the characteristic shortening of the limb was then immediately produced, and the bone could be felt on the dorsum ilii. It was equally easy to reduce the bone into its natural position. So-called dislocation from disease can always be diagnosed by measuring the length of the limb, and observing the position of the trochanter, which is elevated above the natural level. The readiest way of ascertaining this is by what is called 'Nélaton's test.' If a string is stretched from the anterior superior spinous process to the tuberosity of the ischium on the sound side it will be seen that the trochanter is entirely below it, or possibly the upper border of the trochanter just touches the string. On the affected side the trochanter rises above this line to an extent proportioned to the destruction of the neck of the femur. Or, if the surgeon prefers it, he may use Mr. Bryant's or Mr. Morris's method of measurement (see p. 274).

Nélaton's test.



FIG. 219. Congenital dislocation of the hip. From a typical case in which both hips were dislocated, showing the symptoms characteristic of this affection, viz. obliquity of the pelvis, causing lordosis, disproportionate length of the lower limbs, the shoulders thrown back, the legs weak and flaccid, the feet flat. The trochanters are prominent and nearer the spine of the ilium than natural, and the head of the thigh-bone, if of the natural size and shape, can be felt on the dorsum ilii. — From 'Syst. of Surg.' 3rd ed. vol. iii. p. 800.

Diagnosis.

The diagnosis of hip-joint disease is not always easy, at least many mistakes are committed. Excluding hysterical or neuralgic affection, the diagnosis of which from organic disease must rest on the same principles in this as in other joints, the affections usually confounded with morbus coxarius are congenital dislocation, disease of the knee, psoas abscess, caries of the pelvis, disease of the bursa beneath the psoas muscle, and infantile paralysis affecting the muscles of the buttock. The best test is the loss of motion in the affected limb. For in every one of the affections above enumerated the suspected limb can be moved easily and painlessly. This is the case even in those which are accompanied by inflammation, if care be taken to relax and

steady the parts which are inflamed. But some special diagnostic symptoms must be added. In congenital dislocation there is limping, possibly wasting of the muscles, and when the child stands on the limb there is shortening. But he moves quite readily and actively, though with an awkward waddle; the length of the limb can generally be restored by traction, and there is no pain on passive motion. In disease of the knee there is pain in the knee, as there is also in disease of the hip; but careful examination will show the thickening and increased heat of the parts forming the knee-joint, the stiffness on attempts at passive motion, and the other symptoms of disease of the knee. I may just remark in passing that disease of the knee and hip may co-exist, so that the proof of disease of the knee is no actual disproof of hip-disease. In psoas abscess, or in abscess of the iliac fossa or buttock from disease of the pelvis, there are the characteristic symptoms of disease of the spine or pelvis superadded to the freedom of motion of the hip. In some cases abscess in the iliac fossa unconnected with disease of the bones (as from perityphlitis)[1] has been confounded with disease of the hip, from the lameness and flexion of the limb caused by the formation of the abscess. But the special symptoms of hip-disease are absent, and a careful examination will easily detect the difference. Disease of the bursa of the psoas is a rare affection. It may be known by the pain which is produced in the tumour on extending the muscle, and the relief of symptoms and freedom of movement on its relaxation, and by the presence of a resisting and elastic if not fluctuating tumour, of perfectly defined shape and size, in the immediate neighbourhood of the hip. Passive motion of the joint is free and painless, except when it causes pressure on this tumour. Infantile paralysis, when confined to the muscles around the hip (which is rare), sometimes gives rise to mistake on a careless examination, but the painful symptoms of hip-disease are absent, and there is no obstacle to passive motion, while active motion, if any power is left, though limited, is painless.

Congenital dislocation.

Enlarged bursa of psoas.

Infantile paralysis.

The treatment in the earlier stages of hip-disease consists mainly in rest and attention to the general health. If the limb has been drawn into an unnatural position it must be put straight under chloroform, which is always perfectly easy in the early stages, and extension must be applied either by a long splint or by a weight suspended from a pulley at the foot of the bed,[2] which is far better in children, since the long splint irritates them and is constantly displaced. The weight must be proportioned to the age of the child—8–4 lbs. for a young child, and 7–10 lbs. for one approaching puberty, may be taken as a rough average, but this must be ascertained by experiment.[3] Its traction seems to prevent the mutual contact of the inflamed surfaces, and the consequent muscular spasms which are so painful a feature of the disease. Mr. Marsh has recently suggested another way of using weight-extension, so as gradually to restore the limb to its proper position, and avoid the danger which he believes to be incident to forcible replacement of the parts under anæsthesia. He directs that the knee shall be gently straightened, and then that the affected limb shall be brought into such a position as entirely to correct all curvature or inclination of the lumbar spine.

Treatment.

[1] See Gibney on 'Perityphlitis in Children,' 'Am. Journ. Med. Sci.' Jan. 1881.

[2] A diagram of extension by means of the weight will be found on page 283.

[3] I do not see any object in using more force than is necessary to prevent pain and ensure the complete repose of the parts. American surgeons use very much greater extension than that suggested in the text. In a case published by Dr. Taylor of New York, in a child aged thirteen, besides an extending apparatus calculated to exercise a traction equal to 100 lbs., a weight of 50 lbs. was applied to the foot.—See 'London Med. Record,' July 1875.

The affected hip being thus put into its real position (as contradistinguished from the apparent position—the one which the child assumes in order to stand or limp), which is usually one of flexion and abduction (see page 470), the weight and pulley are to be applied in the line of the limb, which is to be supported on a frame for the purpose, and the pulley elevated to any height necessary; or the weight in cases of adduction may be applied at several points of the limbs by pulleys hanging over the side of the bed. Diagrams of various methods of so applying extension will be found in Mr. Marsh's lectures, 'Brit. Med. Journ.' July 28, 1877. As the muscular irritation subsides, the direction of the extension is insensibly altered till the limb is put straight. In cases where the inflammatory symptoms are unusually severe, leeches may be applied in the groin, and where there is much pain blisters or the light application of the actual cautery in the neighbourhood of the joint are often of service. But prolonged rest in bed is the main agent in the cure of the disease, and this confinement to bed, far from being deleterious, is generally attended with considerable improvement in the general health. In summer weather, if the patient's circumstances admit of it, his bed should be placed on a wheeled couch without disturbing him, and he should enjoy the fresh air; but so long as there is any tenderness of the parts on motion no disturbance of the hip should be permitted. How long that may be it is very hard to say. I have known cases treated early recover after less than half a year's rest, while more obstinate cases will require several years; but when taken in the earliest stage of the complaint hip-disease is often curable most completely, with no loss of motion, no change of shape of the parts, and no defect of health; and this forms a powerful motive for recognising the earliest symptoms of the affection. Those symptoms are often very insidious; there is little or no tangible pain, the child is often believed to suffer only from 'growing pains,' and the limping may not be constantly noticed; but the stiffness of the joint on passive motion, and the pain which is produced by attempts to move the thigh, especially in the sense of abduction,[1] are symptoms which careful examination can hardly fail to verify at any period at which the disease can be diagnosed.

Splints for constant extension.

American surgeons profess to treat cases of hip-disease from the first, or after a very brief period, without confinement to bed, the limb being put up in a splint, which makes constant extension by means of a screw and ratchet while the child moves about.[2] The only apparatus of this sort of which I have had any experience is Sayre's, and I cannot say that the experience has been satisfactory. Though when first applied it seems to answer well, yet after a short time it gets displaced and allows passive and active movement of the joint, and I have sometimes thought that the progress of the disease was distinctly traceable to its use. Many other surgeons speak in the same terms of this treatment.

Thomas's splint.

When the patient is able to leave his bed, the splint invented by Mr. Thomas, of Liverpool, has been found very useful, and I am told by Mr. Marsh that the employment of this splint at the Hospital for Hip-disease has materially shortened the average period of confinement to bed. Mr. Marsh thus describes and figures it. 'The object is to keep the joint completely fixed while the patient is allowed to walk about on crutches and with a patten on the opposite foot to raise him slightly off the ground. It consists of a flat piece of malle-

Marsh's description of this splint.

[1] Holmes's 'Surg. Dis. of Childhood,' 2nd ed. p. 441.

[2] Sayre, 'Lectures on Orthopædic Surgery;' Taylor, 'On the Treatment of Disease of the Hip-joint.'

able iron, 1 inch by $\frac{1}{4}$ of an inch for adults, and $\frac{3}{4}$ of an inch by $\frac{3}{16}$ of an inch for children, and long enough to reach from the lower angle of the shoulder-blade, in a perpendicular line downwards, over the lumbar region and the pelvis, slightly external to the posterior superior spinous process of the ilium, over the prominence of the hip, and along the course of the sciatic nerve to a point slightly internal to the centre of the extremity of the calf of the leg.

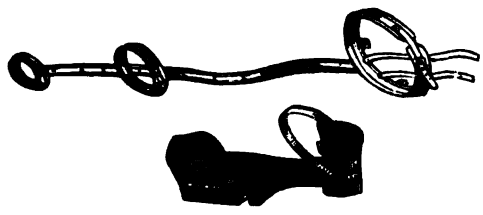


FIG. 220.

The iron must be modelled to this track to avoid excoriations. This iron forms the upright portion. The upper cross-piece, which buckles round the chest, is made of hoop-iron firmly riveted to the upright. It is moulded of an oval form, to prevent rotation of the splint and inversion of the limb. Two other pieces of hoop-iron are fastened to the upright—one at its lower end and the other a little below the fold of the buttock. This splint when padded and adjusted to the limb (see Fig. 221), maintains the joint at perfect rest. Should deformity be present, the splint is adapted to the distortion, and then is very gradually straightened as the parts yield, and in this manner the limb is brought into its natural position. A wooden clog like those worn by draymen (Fig. 220), is more convenient for raising the opposite limb than the patten shown in Fig. 221. Although I am convinced that distortion may be best removed by means of the weight, I have no doubt Mr. Thomas's splint is also useful to correct it. I have often used it with the best results for fixing the joint in cases in which movement produced severe pain. It enables us to move patients safely from room to room, even when the disease is still acute. It is very efficient in preventing recurrence of flexion. It entirely supersedes the various shield-splints, whether of leather, gutta-percha, plaster of Paris, &c., which have been moulded on the hip to 'protect the joint.' These are nearly useless, since by stopping short of the thorax, they cannot fix the articulation. During convalescence or in subacute cases, patients get about very well on crutches with the splint and the patten; but remember there is some danger that they may accidentally fall, or may take to rough exercise; and therefore, let them be always carefully watched; remember, too, that the splint is not so appropriate when the patient is to lie long in bed. The close confinement to the horizontal posture which it enforces would grow extremely irksome; the weight treatment is better for such cases. Lastly, notice that, while wearing the instrument, the child should have a soft bed. On a firm mattress, the splint thrown out into relief would lead to painful pressure.'



FIG. 221.

Dr. J. C. Hutchinson of New York[1] recommends the elevated clog on the sound side with crutches but without any other apparatus, believing that the weight of the limb will produce sufficient extension and the muscles will

[1] 'Am. Journ. Med. Sci.' Jan. 1879.

instinctively retain the part at rest, and when there is no malposition and little if any pain this plan seems to me sufficient.

Treatment of abscess.

It is not advisable, I think, to open abscesses connected with diseased hip unless there is some special reason for doing so. I have seen unmistakeable abscesses disappear; and even if they are to burst it is better to allow the deep parts as long a time as possible to consolidate before the opening forms. If the abscess seems to be increasing, its evacuation by means of the aspirator is very desirable. Other surgeons, and among them Mr. Marsh, think it better to open all these abscesses early. I cannot do better than refer the reader, on this as on other points connected with this subject, to Mr. Marsh's excellent series of Lectures in the 'Brit. Med. Journ.' for July and August, 1877.

Excision.

In the third stage, when the bones are obviously diseased, the question of excision becomes a practical one. The answer to this question will depend mainly on the prospect that we believe the patient to have of spontaneous cure; and this again depends on the means he has for procuring long-continued rest, with careful nursing. If this can be had, more patients I believe will get well than after excision, and with better limbs; but in the poor children whom we are often called upon to treat, it may be more judicious to remove the parts, and if this is to be done with any prospect of success it should not be delayed too long. The operation is not a very severe one, and it leaves a very useful limb, though I think generally the shortening is greater and the union not so firm and strong as after natural ankylosis.[1] For the details of the operation I must refer the reader to the chapter on OPERATIVE SURGERY.

Amputation in hip-disease.

In some cases of disease of the hip, it seems justifiable to amputate at the hip-joint, either primarily or after the failure of excision. The cases in which hitherto I have seen this done, are—1. Those in which the femur is so extensively affected as to render it impossible to excise. 2. Those in which after excision the wound will not heal, or the limb is left useless. 3. When osteomyelitis attacks the femur, and the operation is needed in order to preserve the patient's life.[2]

Other affections of the hip.

The hip is also the seat of many other diseases. The ordinary so-called 'strumous' disease is one of the common affections of childhood, yet an identical affection is not by any means unknown in later life; and it is curious, but I believe true, that the disease in the adult is less severe and dangerous to life than in the child. I have often noticed this with surprise, and recently saw the observation confirmed in a paper by Dr. Taylor of New York. Then we meet comparatively often with affections of the great trochanter or its neighbourhood, sometimes with, sometimes without, suppuration, which it is difficult to separate from hip-disease, and which may, in fact, spread to the hip. These are usually the consequences of falls or blows, and they demand careful but decisive treatment, in order, if possible, to avert the implication of the joint. Rest and counter-irritation before suppuration sets in, and free incision, exposure of the carious or necrosed bone, the removal of sequestra, and the application of sulphuric acid to the softened bone, are the chief indications.

Chronic rheumatic arthritis has its favourite seat in the hip, so much so

[1] On this subject see a Clinical Lecture on some cases of cure after excision of the hip in 'Med. Times and Gaz.' November 3, 1877. See also, on this point and on the general questions of the indications for excision of the hip, the Report of a Committee of the Clinical Society, 'Clin. Trans.' vol. xiv.

[2] For cases illustrating these three classes, see 'St. George's Hospital Reports,' vol. i. p. 147; Holmes's 'Surgical Treatment of Children's Diseases,' 2nd ed. p. 401; 'British Medical Journal,' Jan. 22, 1876, p. 116.

that the disease was for a long time only known in that joint, and called malum coxæ senile. The change of shape in the parts producing shortening of the limb, the wearing pain, the slow course of the disease, the crackling on passive motion, plainly mark the nature of the affection. The treatment is usually unsatisfactory (see p. 465).

Sacro-iliac disease.

Closely connected with disease of the hip is disease of the pelvis. In fact, we have seen that some amount of disease of the pelvis almost always accompanies the last stages of hip-joint disease. But the most characteristic affection of the pelvis is that which occurs at or near its junction with the spinal column. In many cases which are diagnosed as sacro-iliac disease it is probable that the disease affects the bones of the pelvis or spine as much or more than the sacro-iliac joint itself; but when the disease is localised in the articulation its characteristic sign will be pain in sitting, standing, or walking; in fact, in any action which brings the weight of the body to bear on the pelvis. On examination it will be found that there is no pain when the hip is moved, or when the spine is flexed or extended, provided the pelvis is kept steady, but there is pain when the pelvis is moved on the spine. There is also swelling or some puffiness about the part, with increased heat to the hand or to the thermometer, pain running along the course of the lumbar nerves, and sometimes flexion of the hip from irritation of the psoas muscle. These latter symptoms may cause a suspicion of disease of the hip or spine, but careful examination will show that the movements of these parts are free and their temperature is not elevated, while the heat and pain about the sacro-iliac joint will point to the real seat of the mischief. The prognosis depends on the age of the patient, and on the stage which the disease has attained when the treatment has commenced. When the patient is an adult and the disease has proceeded to suppuration, the prognosis is generally unfavourable, though instances of recovery are not wanting. It must be treated, like disease of the spine, by complete rest, with proper attention to diet and regimen, so that the patient may be supported through the stage of exhaustion or hectic which may possibly supervene until ankylosis is obtained. As in disease of the spine and hip, it seems better to allow abscesses to open spontaneously, unless they are causing irritation.

The diseases of the knee having been taken as typical of those of the joints generally, no further remarks need be made on them here.

Disease of the ankle and tarsus.

The ankle is, perhaps, next to the knee and hip, the most frequent seat of disease, and it is also very commonly implicated in inflammation of the tarsus. It is, therefore, very important to study carefully the diagnostic signs between disease limited to the ankle-joint, disease limited to the astragalus, the os calcis, or the joints between these two bones, general disease of the tarsus, and disease implicating the ankle and tarsus simultaneously. Disease when limited to the ankle-joint is marked by effusion into that cavity, which raises up the extensor tendons and produces fluctuation on either side of them, and as it increases presents at one or other or both borders of the tendo Achillis. The movements of the foot on the leg are painful, and if the disease has proceeded to denudation of the bones crepitus may be felt under anæsthesia, or there may be sinuses from which the probe can feel bare bone in the joint. At the same time there is no increase of heat, no swelling or tenderness over any part of the os calcis, except possibly just the upper part, where it is overlapped by the articular effusion; nor over the

Disease limited to the ankle.

Disease limited to the astragalus.

front of the astragalus. Disease which is limited to the astragalus produces swelling, heat, and tenderness corresponding to the position of the inflamed bone, and, therefore, very close to the ankle-joint, but unaccompanied by the effusion beneath the extensor tendons, or the pain on passive motion. Still it must be allowed that the diagnosis is a difficult one, and that the cases in which the disease commencing in the astragalus does not implicate the ankle are exceptional. Such cases are, however, met with, and it has occurred to me several times to remove the whole astragalus for extensive disease of the bone, leaving a healthy ankle-joint, and with complete success. Disease of the tarsus has very commonly its starting-point in the joints between the astragalus and os calcis, as Sir B. Brodie long ago pointed out, though it ordinarily begins in the structure of the bone. When the astragalo-calcanean joint is the seat of the affection there will be pain, tenderness, swelling, and heat about the upper part of the os calcis, and the movement of the calcaneum on the astragalus will be painful, though that of the foot on the leg is not. Careful manipulation is, however, necessary to discriminate this. I had recently a case under my care in which the joint was so entirely destroyed and the bones so universally carious that movement elicited such loud crepitation as to be mistaken for disease of the ankle itself. In this case the painlessness of flexion and extension of the foot ought to have obviated the error. Rest and counter-irritation before the formation of matter, and early incision with continued rest afterwards, are the essentials of treatment. The patient need not, however, be confined to bed after the abscess is opened. The foot should be put up in a plaster-of-Paris splint, with a hole cut for the opening, and he should go about, resting the knee on a wooden leg. In inveterate cases, where the bone is exposed, and the disease threatens to spread, the foot may often be preserved by excising the os calcis and removing any part of the astragalus which is diseased. Other surgeons have removed the astragalus or excised the ankle-joint including the astragalus, and then gouged away the carious portion of the calcaneum. Latterly Mr. Annandale has proposed and practised a formal operation for the resection of the affected joint itself, which will be found described in the chapter on EXCISIONS OF BONES AND JOINTS. Disease of the calcaneum is easily known by the presence of swelling limited to the bone, or of sinuses, all of which lead towards or to it, and by the absence of all the special symptoms above enumerated as characteristic of disease of the ankle, astragalus, and astragalo-calcanean joints.

Disease of the astragalo-calcanean joint.

Disease of the os calcis.

General disease of tarsus.

The presence of general disease of the tarsus is usually indicated by extensive swelling of the whole of the foot and by pain in all its movements; indeed, all use of the foot is soon lost. And in all cases of disease of these parts the foot should be carefully examined under anæsthesia before any serious operation is contemplated, in order to ascertain whether or no these various affections are combined, as they so commonly are. It would, of course, be a serious error to excise the ankle-joint or resect the os calcis if the tarsal bones left behind be in a state of chronic softening in the one case, or the ankle-joint diseased in the other. This is an error which is, perhaps, not often committed, but it is, on the other hand, exceedingly common to see a foot amputated for supposed 'strumous disease of the tarsus,' when on examination the affection turns out to be limited to one of the tarsal bones, and the patient might have been cured by a less extensive mutilation.

Diseases of the joints of the upper extremity are as a general rule more curable than those of the lower. Besides the generally less serious character

of all affections of the upper limb as compared with those of the lower there is the powerful consideration that the joints of the upper limb have not to bear the weight of the body, and can be easily kept at rest while the patient is moving about and getting air and exercise.

Of the sterno-clavicular joint.

Diseases of the sterno-clavicular joint are rare, and as far as I have seen occur generally in persons of bad constitution, and are to that extent to be looked on with suspicion, though recovery not unfrequently takes place, even after extensive abscess and destruction of the joint. Rest, the prompt removal of sequestra, and the sulphuric-acid treatment to any exposed bony surfaces, are the general indications.

Of the shoulder.

The shoulder is far less frequently diseased than any of the other large joints, notwithstanding its constant movement, and its exposure to all sorts of injury ; and when inflammatory disease does occur the prospect of recovery with a useful limb is tolerably good, provided treatment be early, patient, and judicious. Osteoarthritis, however, is rather common in later life, and will in all probability impair the use of the joint, and prove a source of pain and trouble during the patient's life. I have already pointed out (p. 262) how the change in shape of the head of the bone, the new cavity which is often worn in the scapula, the erosion of the biceps tendon, and the loss of the mobility of the joint, occurring in this disease, have been confounded after death with effects of partial dislocation. The disease is easily recognised during life by the crackling in the joint and the change in shape of the parts, together with the wearing pain. The treatment is, unfortunately, a less easy problem (see p. 465).

Inflammation of the shoulder-joint may long exist without suppuration, and its diagnosis from nervous affection demands much care, patience, and attentive examination, under anæsthesia if necessary. Rest and counter-irritation should be persevered in so long as much pain is produced by motion, but no longer. Too long confinement is apt to produce rigidity of the lower part of the capsule, depriving the patient of the power of raising the arm. When suppuration occurs, the matter is often directed by one of the tendons around the joint to a considerable distance, so that the real origin of the discharge is occasionally overlooked for a time. Another source of ambiguity is the occasional occurrence of disease in the bursa which lies between the deltoid muscle and the head of the bone, which does not communicate with the joint.[1] I once treated a case in which the swelling beneath the deltoid, the pain on motion, and the crepitation which was perceived on rotating the head of the bone led to the diagnosis of disease of the joint. On cutting down through the fibres of the deltoid the bursa was laid open, filled with a mass of lymph and pus ; the joint was found healthy, and all the symptoms subsided.

The excision of this joint is so successful, that, if the symptoms demand it, no hesitation need be experienced in recommending it. At the same time the surgeon must remember that the natural cure, by ankylosis, if it can be obtained, usually leaves at least as useful a limb as that after excision, and he should therefore only recommend operation when he thinks the patient is losing ground, or when it seems necessary to hasten the cure.

Of the elbow.

The elbow is a very frequent seat of carious disease, and in some rarer cases of necrosis. Dislocation very rarely occurs, except of the head of the

[1] The synovial fold which exists beneath the subscapularis, and is spoken of as its bursa, is really a part of the synovial membrane ; and when the infraspinatus has a bursa below its tendon this also forms a part of the joint.

radius, which is comparatively often found on the back of the outer condyle, a displacement attributed to the hand having been kept in the pronated position. This position should therefore be avoided in disease of this joint, the forearm being placed at an acute (not a right) angle with the arm, and in the position midway between pronation and supination. When abscess has formed and the bone is exposed I am in the habit of recommending excision, provided the patient is in good health. It is true that the disease is limited in many of these cases: in some after the removal of a sequestrum, or after cutting off a portion of the articulating surface, a cure has been obtained with a moderately useful limb, and in many a natural cure by ankylosis would ultimately result; but on the whole it seems that the free excision of the joint is both more certain in its prospects of prompt recovery, and more promising as far as the utility of the limb goes, than either of these other operations.

Chronic rheumatic arthritis of the elbow is generally accompanied with a similar affection of other joints, otherwise it would be a question whether excision might not be recommended in some of these cases. It is probably this affection which generally is the cause of the occurrence of loose cartilage in this joint. Next to the knee loose cartilage is perhaps more common in the elbow than elsewhere; but I never saw a case operated on.[1]

Of the wrist and carpus.

The wrist and carpus are often diseased and that to a very great extent, and especially at late periods of life, in the class of patients who are met with at hospitals, though far more rarely in persons who are exempt from manual labour. Chronic rheumatic arthritis also attacks this joint and sometimes produces a pseudo-dislocation, or so changes the relations of the parts that dislocation occurs on some slight injury. The effects of disease of the wrist on the tendons whose action is necessary to the use of the hand are perhaps as formidable as the direct injury to the joint, and when the disease has proceeded far the results of all methods of treatment are imperfect. The early treatment, therefore, of such cases is very important; but from the circumstances of the patients it is but seldom that an opportunity is obtained for it. When suppuration has occurred the abscesses should be early and freely opened, the parts should be kept at rest on a splint, and passive motion carefully given to every joint which admits of it, the patient being also encouraged to use as much voluntary motion as he can without much pain.

It is only in the last resort, and as a substitute for amputation, that excision ought to be proposed.

[1] Hueter excised the elbow in a case in which there were numerous loose bodies in the joint. I once excised this joint for chronic rheumatic arthritis, and with a very good result.

CHAPTER XXIV.

DISEASES OF THE SPINE.

Caries of the spine.

CARIES of the spine, or, as it is sometimes called simply 'disease' of the spine, is very frequent among strumous and other weakly children and young persons, often following on slight accidents, but as often occurring spontaneously—insidious, and marked by few or no symptoms in its commencement, but leading to the gravest lesions in its progress, and very frequently fatal.

It affects any part of the spine, from the highest cervical to the lowest lumbar vertebræ, and *cæteris paribus* is more dangerous the higher in the column the affected part is. It has its origin always in the spinal column itself—i.e. in the body of the vertebra, or the intervertebral substance[1]—rapidly spreading from one to the other. In the cancellous tissue of the vertebra it seems to originate either in a deposit of tubercle, which softens, or in a low inflammation, leading to suppuration, which spreads through the bone. In the intervertebral substance its pathology is the same as that of other ulcerations of cartilage (see DISEASES OF JOINTS). In some rare cases the inflammation commences in the softening of one or more syphilitic gummata, of which a very interesting example is described and figured by Mr. Barker in his essay on 'Caries of the Spine.'[2] The inflamed bone furnishes pus, which is at first limited by the structures around the spine, condensed into a kind of sac for it (Fig. 223), and the abscess may remain quiescent in this state for an unlimited time, then dry up and be absorbed, leaving little trace of its former presence; or it may spread to a considerable distance, very commonly passing along the sheath of the psoas muscle into the thigh (**psoas abscess**), or between the transverse process into the loins (lumbar



FIG. 222. Angular curvature of the spine. The preparation is viewed from the right side. There is no difference whatever between the size of the two pleural cavities. The smooth surface, *a*, is a buttress of new bone, the result of inflammation, which has replaced or has soldered together the remains of the bodies of seven dorsal vertebræ. At the side of this is seen a mass of rough, irregular bone by which the heads of the corresponding ribs are ankylosed together. The projecting spinous processes are also firmly united by bone.—From a preparation in the Museum of St. George's Hospital, Ser. v. No. 27.

[1] The disease almost always arises in the bone, but preparations are not wanting showing its occasional commencement in the intervertebral disc.

[2] 'Syst. of Surg.' 3rd ed. vol. ii. p. 421.

abscess), or presenting behind the pharynx (postpharyngeal), or (though this is very rare) making its way into some of the neighbouring cavities or viscera, so that spinal abscesses may burst into the pleura, the lungs, the peritoneum, intestines, kidneys, urethra, bladder, &c. The affected vertebræ and intervertebral discs are thus gradually removed—the latter often resisting their destruction longer than the bones do; and then the column gradually sinks together, the arches and spines of the destroyed vertebræ being thrust backwards along with the spinal cord, forming an angular projection in the back (angular curvature), while the vertebræ, or the remains of vertebræ, now brought into unnatural contact, become ankylosed or soldered together (if the patient is to recover), and thus the humpback is produced with which we are so familiar. The enormous loss of stature which many of these persons present shows how extensive may be the destruction from which a patient may recover without loss either of life or of spinal power. At the same time the disease is very often fatal by itself, the patient dying either from exhaustion or from the inflammation of the sac of the abscess, or from inflammation of or pressure on the cord, or from some complication, such as the bursting of the abscess into the peritoneal cavity; and a good many such patients die of concomitant internal disease, chiefly phthisis.



FIG. 223. Angular curvature of the spine in the lower part of the dorsal region. The bodies of the lower dorsal vertebræ and the first lumbar have been extensively destroyed by caries. In the neighbourhood of the disease are the remains of the parietes of a thick cyst, at the bottom of which may be seen the thickened theca vertebralis.—St. George's Hospital Museum, Ser. v. No. 18.

The immunity which the cord so commonly enjoys in disease of the spinal column, even when the latter is of very great extent, is so remarkable a phenomenon that we must endeavour to give a distinct explanation of it, as well as of the nature of the affection of the cord when it does occur. The reasons why the cord commonly escapes disorganisation from pressure or inflammation are threefold: (1) the very gradual progress of the change of form in the column allows the spinal cord to accommodate itself to its new position: also we must not forget that the vertebral canal is much larger than the cord; (2) the gradual falling forward of the upper part of the column pushes the abscess forward, as shown in Fig. 223, and prevents it from making its way towards the spinal canal, and propagating inflammation into its interior; and (3) the theca vertebralis protects the medulla from implication in the affection of the column. For these reasons the spinal marrow generally escapes both pressure and inflammatory softening; but it does not always do so. In rare cases, as the result of sudden giving way of the column, either spontaneously or from violence (as in the well-known case in which a quack undertook to straighten the column in a case of caries), the cord may be crushed, just as in any other case of fracture of the spine, with the same result of instan-

taneous and total paralysis of motion and sensation, which will in all probability be permanent. More commonly the spinal cord is affected only by inflammatory changes in its anterior portion, or possibly by partial pressure, either from abscess pressing on it in front or from bending at the angle, and in such cases only the motor roots of the nerves are implicated, and sensation is perfect. It is much rarer for sensation to be affected as well as motion, and for sensation to be alone affected seems to be unknown.

Many such cases of paraplegia end in recovery, but in some the lower limbs remain withered and paralysed. The paralysis of the sphincters is almost always temporary.

The diagnosis of caries of the spine is by no means easy in all cases. When there is no abscess perceptible, and no curvature, the symptoms are, pain in the back in a fixed spot, increased by movement and particularly by percussion of the affected part of the spine, sometimes to an exquisite degree; tenderness confined to the spinal column, and possibly some amount of thickening or even of increased temperature around the diseased bones. The affected part of the spine is kept rigid, producing a very characteristic attitude when the disease is situated in the upper part of the neck. Hysterical or neuralgic pain often closely simulates caries, but is not so constant and equable; it is usually accompanied by tenderness, not of the spine only, but diffused over the back, and frequently joined with other symptoms of hysteria or with uterine disturbances. The growth of a tumour from the vertebræ may at first be indistinguishable from caries, but the progress of the case will soon clear up all doubt. Frequently the early stages of caries are not accompanied by any decided symptoms, and I have seen even large abscesses connected with extensive caries of the spine discovered in post-mortem examination of persons who have never made any complaint leading to the suspicion of such a disease. When curvature exists there is no longer room for doubt; in some few cases, indeed, lateral curvature does to a certain extent simulate angular, but an attentive examination will usually clear up the case.

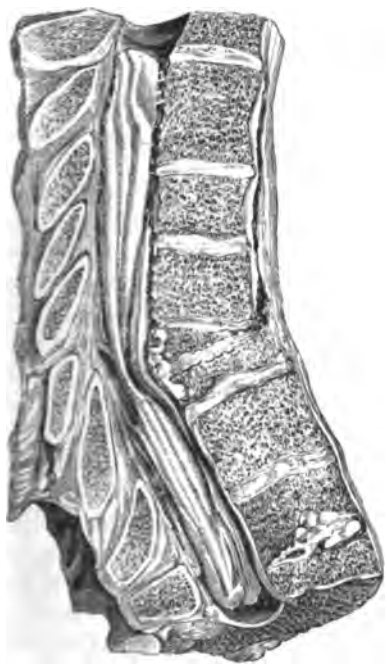


FIG. 224. Compression of the cord by a displaced fragment, in caries of the spine. The seventh and ninth dorsal vertebræ have been partially destroyed, while the body of the eighth is represented only by an angular fragment between them, which has been thrust backwards so as to compress the cord. Paralysis, however, was not total.—From a drawing (Ser. xxi. No. 40) presented by Sir B. Brodie to the Museum of St. George's Hospital.

In many cases of caries of the spine recovery takes place without visible abscess, even when the deformity testifies to considerable loss of substance. In some of these cases, on dissection, the inspissated remains of a definite collection of pus will be found;[1] but there is no proof that this is always the case. As softened bone is removed without suppuration when the spine

[1] As in Mr. Barker's case, related on p. 418 of his essay.

is eroded by the pressure of an aneurism, so it seems that the bone when softened by inflammation may be removed without the formation of pus,[1] though this is of course more rare. It is in the remains of old dried-up spinal abscesses that the *residual* abscesses, spoken of on p. 29, have one of their most common seats.

Abscess from diseased spine.

Spinal abscess is generally psoas or lumbar. Little more need be said about lumbar abscess. It presents at the outer edge of the erector spinæ muscle, between the ilium and ribs, and the only questions which occur in its diagnosis are usually whether it is a simple abscess or one caused by diseased bone, and in the latter case whether the disease is in the spine or pelvis. These questions will be settled by the symptoms and by examination of the parts. When the pelvis is diseased it can often be felt with the probe; but the spinal disease, being situated on the front of the column, is out of reach.

Psoas abscess.

Psoas abscess, however, constitutes a distinct surgical disease, the diagnosis of which, as well as its treatment, requires special rules. The disease in the spinal column which gives rise to it is often seated above the origin of the psoas muscle, the pus travelling down the front of the column in the posterior mediastinum till it makes its way beneath the ligamentum arcuatum internum, and so gains the sheath of the psoas—sometimes on both sides. It then travels down the loins, forming a fulness which can often be distinctly recognised at the side of the lumbar spine, and sometimes irritating the muscle so as to produce flexion of the thigh and pain on attempts to extend it.[2] It then fills the iliac fossa, passes beneath Poupart's ligament on the outer side of the vessels, and crosses beneath the femoral sheath to the inside of the thigh, where it usually stops, presenting and bursting just below the groin; but in rarer cases it may travel a long distance down the thigh before it bursts. The diseases with which psoas abscess is likely to be confounded are femoral hernia, simple abscess, cystic tumour, cancer, and aneurism. Like femoral hernia, it often has a distinct impulse. Its orifice of communication with the iliac fossa and the portion of the abscess external to the vessels is often so small as not to be readily discovered. But the fulness in the iliac fossa is usually quite sufficient to distinguish it from hernia, even if the pain in the spine and deformity be absent. And although a psoas abscess may be to a certain extent reducible on pressure in the recumbent position, this is merely a diminution of size, quite different from the sudden and complete disappearance of hernia. From simple abscess and from cystic or bursal tumour the spinal symptoms and the fulness in the iliac fossa are sufficient marks of distinction. Cancer may simulate abscess in this as in other regions, but the diagnostic marks are numerous. Singularly enough the disease which most closely resembles psoas abscess is that which would at first sight appear to be farthest removed from it, viz. aneurism, at least that form of disease of arteries to which the somewhat unmeaning name of diffused aneurism is given, i.e. a collection of blood communicating with a diseased artery, and which is often caused by the rupture of a small pre-existing aneurism; at other times by the giving way of a small portion of the artery. The growth of an abdominal aneurism against the spine often gives rise to wearing pain in the back, from absorption of the vertebræ; the tumour, in some cases, does not pulsate, and it grows down the loins just as a psoas abscess would do. So close is the resemblance that the mistake has been

[1] See Barker, 'Syst. of Surg.' 3rd ed. vol. ii. p. 404.

[2] Similar flexion and pain may, however, exist in sacro-iliac disease (see p. 477) and in disease of the pelvis.

committed by some of the best surgeons.[1] Doubtless, in most of these cases auscultation would reveal a bruit; and this, though it might not be decisive of the nature of the disease, would at least induce caution in opening the tumour, and a preliminary exploration with the grooved needle, if the surgeon should still desire to make the opening.

Treatment of spinal abscess.

When the diagnosis of psoas abscess has been established the question of treatment occurs. The patient must be confined to bed and kept in the strictest repose for a very long period. It is better not even to allow him to rise from his back, but merely to turn from side to side; but it is not always easy to enforce such complete repose. At the same time his strength must be supported by nourishing diet, without stimulants, and cod-liver oil or iodide of iron may be administered internally if they agree with the digestion. In fact, the general treatment must be regulated by the constitutional condition. But the main question is whether to open the abscess or no. As a general rule it is better to allow it to burst; but if there is much pain or inflammation, or if it is increasing to a very large size, it will be proper to open it. I have no doubt that this is best done in the manner described by Mr. Lister, i.e. by allowing the pus to ooze gradually through a veil made of lint or muslin saturated with carbolic acid lotion, which is to be replaced by the usual carbolised dressings after the oozing has almost ceased (see p. 28). If inflammation nevertheless occurs (which, however, has never taken place in many cases which I have treated in this way), the sac should be well washed out by injection of carbolic lotion (1 to 40) and a drainage-tube introduced. Other plans are to tap the abscess with the aspirator (p. 207) or with an exhausting-syringe attached to a trocar, or to tap it with a trocar the tube of which passes into a basin of water, so as to avoid the entrance of air. After a considerable quantity of pus has been evacuated the puncture is closed, and after a few days the operation is repeated; or a small valvular puncture may be made, and a poultice applied. The risk in opening these abscesses is the probability of inflammation supervening, marked by rigors, fever, swelling, redness and œdema around the puncture, and foulness of the discharge. This is a dangerous occurrence, likely to lead to death directly from fever or septicæmia, or indirectly from exacerbation of the disease in the bones. Free incision, washing out the cavity with antiseptics, vigorous stimulation, and support are the measures which should be adopted. When the abscess has healed, or remains in the state of a mere inactive sinus, the treatment resolves itself into that of spinal disease only. And the treatment of spinal disease really resolves itself into mere rest—that is to say, the bones themselves should be kept at rest, and all the muscles which act upon them, as far as is possible. So long as the patient can be kept in bed, without detriment to his health, he is better there than moving about; or the bed can be placed on a carriage, and he can be wheeled into another room or

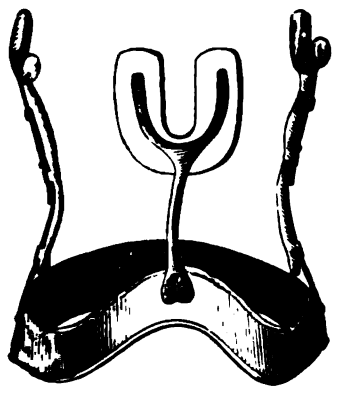


Fig. 226. Apparatus for supporting the spine and receiving the projecting vertebræ, in a case of angular curvature.

Treatment of disease of the spine.

[1] See a paper 'On the Diagnosis of Aneurism.'—St. George's Hosp. Reports, vol. vii. p. 192.

into the fresh air. When it seems expedient, on account of his suffering from confinement, and the bones appearing to be sufficiently soldered, an apparatus may be constructed by which the weight of the upper part of the body is taken off the spine and transmitted through crutches supported on rigid rods to a girdle resting on the pelvis. This should be worn even for a considerable time after it is believed that the bones have become ankylosed. The symptoms of such ankylosis are the disappearance of pain on motion, the wasting of the muscles in the intervertebral gutters, and the fact that all the vertebræ move together when the back is bent. It need hardly be added that no attempt should be made to rectify the curvature, which, in fact, is a necessary part of the cure, and which often becomes more marked as consolidation becomes perfect, and the soft parts waste around the ankylosed bones.

Sayre's treatment for spinal curvature.

Lately an ingenious, and I believe a successful, method of treatment has been introduced by Dr. Sayre of New York, with a view of ensuring local rest for the diseased parts, and at the same time allowing the patient the inestimable benefits of fresh air and exercise. The same treatment also aims at diminishing the deformity, or, at the least, obviating its increase. The patient, who has a flannel shirt or jersey over the chest and abdomen, is to be suspended in a tripod-frame by the shoulders and neck so that his feet just touch the ground; and in doing this the weight of the body somewhat extends the spine and reduces the curvature to its minimum—at least, straightens the column as much as is prudent. Then a pad or a lump of wadding is to be applied to the projecting vertebræ so as to avoid any pressure on the skin over the hump, a pad is placed over the region of the stomach (the 'dinner pad,' as Dr. Sayre names it), and the whole thorax and abdomen is rapidly enclosed in a case of plaster. When this is completed the abdominal pad is drawn out, and the patient is laid horizontally on a mattress or on a water-bed while the plaster is setting. If it be a female adult the breasts must also be padded. When the whole has set, the patient may be allowed to take exercise, though, of course, with caution.

This treatment has been extensively tried, and the general verdict seems decisive in its favour, though possibly the time since its introduction is hardly long enough to show exactly what its value is. No doubt, however, its first effects are surprisingly good, persons who had only been able to walk with crutches, or not able to make any movement without pain, being immediately restored to the power of unaided motion. But this does not of course show whether the definite cure of the disease is rendered more or less probable, or even more or less speedy. Nor have I sufficient experience of the method to enable me to pronounce an opinion as to the desirability of this treatment in the acute conditions of spinal disease, or when abscess is forming. In the more chronic conditions, I entertain no doubt of its great superiority to the elaborate machines of the orthopædists.[1]

Disease of cervical vertebræ.

Disease of the cervical portion of the spine deserves special notice. It is much more fatal than the similar affection of the lumbar or dorsal regions, and it has both special characters and special dangers of its own. The disease is, I think, even more common in childhood, relatively to adult life, than that of the other regions of the spine, and it usually at first simulates mere 'stiff neck,' the pain on motion causing the child to hold its neck stiff. When the disease attacks quite the upper end of the column, so that the movements of the head produce an immediate effect on the carious bones, the child gets a habit of

[1] The reader will find this method of treatment fully discussed in the 'Transactions of the International Medical Congress,' Section on Diseases of Children.

keeping the head instinctively but very carefully fixed in a certain position which is very characteristic, and in turning often turns the whole body, and steadies the head with both hands. Often a slight tap on the top of the head will produce pain. There is usually thickening around the affected vertebræ, very rarely any curvature, the small size and deep position of the spines preventing any recognisable angular deformity; often sinuses about the neck, and frequently postpharyngeal abscess, which causes a swelling or opening at the back of the pharynx (Figs. 226, 227). The chief danger in this disease is that of softening of the upper part of the cord, leading to dyspnœa and speedy death. But another and still more sudden mode of death is that which results from displacement of the odontoid process in disease of the two upper vertebræ, and which is illustrated by the Figs. 228, 229. The former (Fig. 228) shows all the ligamentous apparatus connected with the odontoid process destroyed, with the single exception of a small string of the transverse ligament which has escaped destruction, the patient having died from the exten-



Fig. 226. Caries of the cervical vertebræ and ulceration of the intervertebral discs, communicating with the pharynx by an ulcerated opening. The membranes of the cord were found united to each other and to the posterior surfaces of the vertebræ, and the upper part of the cord was softened. *a*, section of the basilar process; *b*, the opening in the pharynx communicating with the diseased spine; *c*, the epiglottis, with a portion of the tongue below it.
The symptoms were so slight that the ulcer in the pharynx was not known to have any connection with diseased spine till the post-mortem examination. The patient died suddenly, after being in the hospital for a few days.



Fig. 227. The back view of the same preparation, showing: *a*, the base of the skull; *b*, the opening of the pharyngeal abscess; *c*, the posterior common ligament and theca vertebralis, thickened and turned down, in order to show the diseased bone and the opening of the abscess; *d*, carious and exposed surface of some of the lower vertebræ.—From a preparation in the Museum of St. George's Hospital, Ser. v. No. 13.

sive affection of other parts of the vertebral column. Had he lived somewhat longer the slight remains of the transverse and cheek ligaments would have given way, and the same result would have followed as that which is shown by the other figure (Fig. 229). This was taken from the body of a girl aged nine, who had been for some time in St. George's Hospital, with disease of the upper part of the spinal column. One day the nurse was raising her head to wash her, when she fell back dead. The figure shows that the whole ligamentous apparatus which confines the odontoid process has been destroyed; and that process being suddenly displaced backwards and upwards has impinged on the medulla and produced instant death. The same accident has happened in cases where (as in that which furnished Figs. 226, 227) there had been no previous suspicion of disease of the spine. Thus a lady was sitting in her chair, and, turning her head to greet a person entering the room, fell dead.

Another was playing with her child, who pulled her head back, and she died on the spot. In both cases this displacement of the odontoid process was found.

In order, then, to guard against the risk, not merely of this fatal displacement of the odontoid process, but also of the irritation of the spinal cord and of the extension of the disease of the bones by movements of the affected vertebræ, the most rigid rest must be insisted on. It is not enough merely to put the patient to bed. The head and neck ought to be confined in a case of plaster or guttapercha, in the moulding and applying of which all imaginable gentleness should be used;[1] and the patient must never be allowed to rise from the horizontal posture, the sheets being so arranged that they can be changed without raising him. This rigid rest must be continued until the pain



FIG. 228. Disease of the skull and upper part of the spine, in which the transverse ligament has been almost entirely destroyed. There is a large opening through the base of the skull (occipital and sphenoid bones) communicating with the pharynx, through which a rod is passed. Below this the odontoid process is seen exposed by the ulceration of the transverse ligament and its vertical appendage. Only a thin string remains, under which two black bristles are passed. The odontoid process, however, is still retained in position by some remains of the cheek ligaments. The connections between the second and third vertebræ are almost destroyed. The flap turned up at the top of the preparation consisted of the dura mater, covered externally by a quantity of thick scrofulous matter, which had produced pressure on the spinal marrow.—From the Museum of St. George's Hospital, Ser. v. No. 14.



FIG. 229. A preparation showing displacement of the odontoid process backwards from ulceration of the transverse and cheek ligaments in disease of the upper part of the spinal column. Death was instantaneous.—St. George's Hospital Museum, Ser. v. No. 15.

on motion of the head has ceased for some time. In other respects the treatment is the same as in disease of other portions of the spine.

Lateral curvature of spine.

Next in frequency to angular curvature, if not even more common, is what is usually called lateral curvature of the spine, though, as the curvature is not in ordinary cases merely to one side, but each vertebra is also somewhat rotated on that next to it, the distortion is sometimes called 'rotation-curva-

[1] This is better on the whole than putting the head and neck into a kind of sandbath, as is sometimes recommended, or fixing anything on the couch to contain the head, since these will not move along with the patient when it becomes necessary to move him; but, of course, the making of the splint involves some risk.

ture.' The annexed illustration (Fig. 230) shows the spine in a very extreme example of this deformity, so extreme that the atlas in the erect position is only a few inches above the sacrovertebral prominence; and it will be observed that the spine is so rotated that there are vertebræ which look towards each side, and some which are directed almost backwards. This rotation of the vertebræ is obviously caused by some active force which can only be exercised by the muscles inserted into them. The original cause of the distortion, however, appears to be merely passive. The deformity commences in almost all cases about the period of puberty,[1] and in girls far oftener than in boys, the patient being weakly and sickly from confinement, and possibly overstudy, or from menstrual irregularity. In such persons anything which produces habitual inclination of the spine to one side, as the habit of standing on one leg, acting on the lumbar spine, or the habit of carrying a burden (such as a nurse-child) on one arm, acting on the dorsal region, may prove the starting-point of more extensive deformity. The muscles are now thrown into irregular action; and as the attachments of the muscles on the convex side of the curve are approximated, their fibres become indurated and thrown into



FIG. 230. A preparation of extreme lateral curvature (or 'rotation curvature') of the spine.—From the Museum of St. George's Hospital.

chronic action, while the stretched muscles on the other side are proportionally weakened and inactive. The displaced vertebræ are also changed in shape by pressure, so that when the deformity has lasted long the bodies of the vertebræ are much thicker on the convex than on the concave side of the curve, and the transverse processes are almost locked together, and the deformity is, at that stage at least, incurable. When the spine in either the lumbar or dorsal region is thus primarily curved a somewhat similar secondary incurvation commences in the dorsal or lumbar region, produced by the efforts necessary to maintain the balance of the body. This secondary curve is, however, always less marked than the primary one. A third compensatory curve in the cervical region may sometimes be traced in cases of extreme lateral curvature, as in Fig. 230. Lateral curvature in the dorsal region produces, in the first place, a displacement of the ribs and scapula upwards on the convex side of the curve, so that that shoulder is raised higher than the other. This is commonly on the right side; and the first thing which attracts attention is

[1] Eulenberg says that in Germany the disease begins earlier than this—from six to ten years of age—and refers the earlier origin of the disease there to the earlier period at which children are put to school. See 'Lond. Med. Record,' 1877, p. 432.

the 'growing out' of that shoulder, as it is termed. When the deformity is extensive and confirmed, the thorax will be greatly altered in shape, so that the ribs are flattened down, the intercostal spaces nearly obliterated, and the cavity for the lung greatly narrowed, while on the other side it is the reverse. In the lumbar curve the distance between the last rib and the ilium (i.e. the flank) is much increased on the convex side of the curve, while on the concavity it is so much diminished that the patient is sometimes annoyed by the rib impinging on the ilium; this produces considerable falling in of that flank. The hip also is raised and prominent on the convex side of the curve.

The diagnosis is generally simple. The patient being stripped, the line of the spinous processes should be dotted with ink as she stands with both feet flat on the ground and planted together. She should then be made to stoop; the position of the shoulders should be compared, the distance between the ilium and last rib on either side ascertained, and the extent of the thoracic and lumbar curvatures compared. The only affections of the spine which it is possible to confound with lateral curvature are; *a*, curvature from caries; *b*, curvature from rickets; and *c*, curvature from empyema. In some very rare cases of caries of the spine the sides of the bodies are either entirely or chiefly affected, and the spine falls to one side instead of directly backwards; but on attentively investigating the history of such a case there is never any difficulty in discovering its nature; the curve is always limited to a few only of the vertebræ instead of being diffused over the whole region, and is always accompanied by more or less of angular deformity. The curvature from rickets is usually also of an irregular kind, the softened vertebræ projecting backwards as well as to one side. It commences at quite a different period of life from the ordinary lateral curvature, and is generally, if not always, accompanied by deformity of other bones, as the legs or forearms. The curvature which follows on empyema is a truly lateral curvature, accompanied by no rotation, and is always easily distinguished from lateral curvature by the history and by the sinuses.[1]

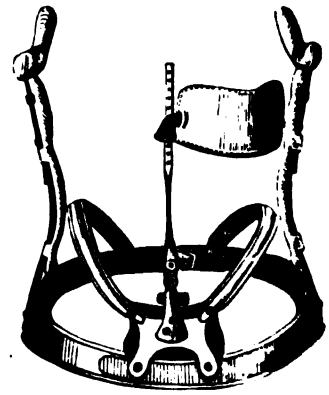


Fig. 231. Apparatus for supporting the spine and pressing the projecting part of the thorax and spine towards the middle line in a case of lateral curvature.

Having fixed the diagnosis, the next thing which is to be done is to ascertain the cause and how the disease has commenced. If it has commenced in the lumbar region as a consequence of inclination of the pelvis depending on unequal length of the limbs (as in diseased hip), the first step in the treatment is obviously to restore the length of the limb by a proper boot, and thus to act on the pelvis. If it seems to depend on a habit of standing on one leg or of dropping one shoulder, that habit must be corrected, and the patient carefully drilled. Any habitual exertion that tends to distort the spine (as carrying a weight, working at a one-armed trade, &c.) must be given up. Gymnastic exercises which call the muscles of the two sides of the body into equable action are extremely useful, under careful supervision, in the early stage of the disease. A long rest in the recumbent position, and with the body in a perfect state of

[1] On the difference between the ordinary lateral curvature and that from empyema, see Dr. Little, 'Syst. of Surg.' 3rd ed. vol. ii. p. 441.

extension, in the middle of the day, after dinner, is also very desirable, as avoiding over-fatigue. The general health must be cared for, and steel is generally indicated. An apparatus may also be applied to press gently on the convex side of the curve in the back and to separate the ribs from the ilium in the concavity of the loins. When the curve is pronounced and the disease inveterate, nothing can be done to correct the existing deformity, though the application of an instrument may be still advisable, in order to prevent it from increasing.

Dr. Sayre's treatment, described above, has been tried in cases of lateral curvature also, and seems to me very applicable to such cases. But here great care must be taken, in applying it, to see that the spine is straightened as much as possible before the plaster is applied; and I think the dressing should be frequently renewed, in order to see that it does not injuriously confine the parts, and also to renew the extension.

Other spinal curvatures: kyphosis; lordosis.

The other curvatures of the spinal column are kyphosis, or the general antero-posterior curve which is common in weakly children and in old men; and lordosis, or the incurvation of the bodies of the lumbar vertebræ forwards. The term kyphosis is sometimes applied to all antero-posterior displacement, including angular curvature; but it seems to me better to speak of the latter by itself. Kyphosis occurs in early infancy from mere relaxation. In fact, the spine has no pronounced curves in early life, and when the baby is made to sit up for a time the back will always be found to be bowed; but this bend is only temporary, and is effaced by suspending the body from the shoulders. Weakly children suffer in the same way from what is called in schools 'cat's-back'—the chin poking forward and the spine projecting often to such an extent that the case is mistaken for one of incipient angular curvature. But attentive examination shows that the curve is uniformly distributed, unaccompanied by pain or inflammation, and capable to a great extent, if not entirely, of obliteration by gentle extension or suspension. It will disappear with rest, strengthening, and correction of any lazy habit of stooping; or, if extreme, some bandage to the back may be necessary. The kyphosis of old age can hardly be mistaken. It is not susceptible of more than partial relief from rest and support.

Lordosis, or saddleback, is caused chiefly by disease or congenital dislocation of the hip (Fig. 219, p. 472). It is, therefore, a secondary change, the treatment of which must consist mainly in the correction of the primary displacement. The forward inclination of the pelvis which produces the lordosis is necessitated by the backward displacement of the centre of gravity of the body caused by the dislocation of the hip. Hence the first step is, if possible, to remedy this displacement. This may be sometimes effected, in congenital dislocation, by fixing the head of the bone, if movable, in or near its natural position, or in ankylosis by dividing the neck of the bone and putting the limb straight. When this has been done extension by an appropriate instrument will diminish the lumbar curve, though it is not probable that it will succeed in wholly rectifying it.

Ankylosis.

Ankylosis of the spine is another condition not very uncommon in old age, and is one of the causes of the rigidity of the spine in advanced life, though by no means the only or, perhaps, the most common. It is probably allied to, or associated with, chronic rheumatic arthritis. The anterior common ligament is often in these cases found converted into a mass of bone, and

the ossification seems to have invaded also the invertebral discs. It is, of course, incurable.

Cancer of the spine.

Tumours of all kinds may be found in the spinal canal, but I cannot spare the space required for their detailed description, nor do I consider it necessary. The symptoms are those of irritation or of pressure on the cord, together with absence of proof of any disease in the bones; but the diagnosis is seldom made quite confidently till a post-mortem examination shows the nature of the tumour. The only other affection I shall speak of is the carcinomatous deposit which is found in the bones of the spinal column, sometimes as a primary disease, sometimes as secondary to cancer in other parts, and especially to scirrhus of the breast.[1] The disease is seen at all periods of life (Mr. Hawkins relates the case of a child five years of age), but is more common after middle age. The form of cancer is usually encephaloid, though scirrhus is not unknown, and possibly many of these tumours would now be described as sarcomatous. The symptoms are often very severe—great pain, severe muscular spasms from irritation of the nerves emerging from the affected portion of the spine, paralysis more or less extended, rapid emaciation, and death. When the disease occurs primarily the diagnosis can only be confidently made if the tumour can be felt, though the severe localised pain and the rapid wasting may cause a suspicion of the nature of the malady. In cases where cancer in other parts has preceded, or is still present, less hesitation will be felt.[2] All that can be done is to soothe the patient's sufferings by the free use of narcotics, and to insist on total rest.

Spina bifida.

Spina bifida is a tumour formed by a congenital hernia of the spinal membranes (dura mater and arachnoid), through a cleft left in the arches of the vertebræ by incomplete coalescence of their laminæ. The disease is more common in the lumbar than in any other region (though it may occur in either the cervical or the dorsal), and this is consistent with the fact that the closure of the arches takes place gradually from above downwards. As in the analogous tumours in the brain (meningocele), there is not only want of closure of the bones but also dropsical effusion in the sac of the membranes. The sac of the tumour is formed by the skin and the dura mater and arachnoid, but it always contains the cerebro-spinal fluid. Sometimes also the pia mater and the cord, or in the lumbar region the nerves of the cauda equina, are carried into the sac, and united to it in the middle line (Fig. 282). In some cases the skin is more or less deficient over the tumour, exposing the membranes through which the fluid shines as through a thin bladder. On the other hand, the skin has been found much thicker than natural. There are often other deformities, such as clubfoot, harelip, hydrocephalus, or meningocele; and if the child survives permanent paralysis of the sphincters or paraplegia may result. But as a general rule such children do not long survive. The tumour often bursts, and fatal convulsions come on, or the child is too weakly to resist some of the ordinary ailments of infancy. Still there are cases on record in which a person with spina bifida has been known to survive to and beyond middle life[3] without any apparent drawback

[1] See Cæsar Hawkins's 'Contributions to Path. and Surg.' vol. i. p. 380; 'Med.-Chir. Trans.' vol. xxiv. p. 45.

[2] I saw a singular case of cancer once, in which, after severe pain in the spine, but without paraplegia, one of the vertebræ was found to crepitate distinctly on the other. After a few days this symptom disappeared, the soft mass having grown in between the two vertebræ.

[3] In a published case the patient survived to the age of fifty, and I have heard of older cases in private. See Holmes's 'Surg. Dis. of Childhood,' p. 83.

from the disease; and at least one remarkable instance is recorded in which a tumour which was believed to have been a spina bifida (though it was more probably a meningocele) gradually lost its communication with the cerebro-spinal canal, and was removed from the back of the neck as a simple cyst;[1] and other instances of spontaneous cure are recorded. Viewing, then, the great danger of any effectual surgical treatment, it seems better to watch the case carefully, and not to interfere unless the tumour is growing. In that case the tumour should be tapped with a fine trocar on one side, since when the nerves are in the sac they always adhere in the middle line, and as much of the fluid should be drawn off as will decidedly relieve the tension. A shield or compress of guttapercha, well padded, should then be applied. Under this treatment, by repeated tapping, some cures have been effected.[2] In other cases there seems no doubt that a radical cure has been produced by the injection of tincture of iodine. The plan which has had most success is that introduced by Dr. Morton of Glasgow.[3] He uses a solution of iodine gr. x. and iod. of pot. ʒ ss. in an oz. of glycerine, of which about half a drachm is injected into the sac after the tumour has been about half emptied. Every precaution must be taken to avoid the entrance of air during the operation, and to keep the puncture securely closed afterwards. It may be necessary to repeat the injection. In a letter received from Dr. Morton, in the year 1882, he told me that he then knew of thirty-two cases treated strictly on this method, of which twenty-six had been successful. Six had died, but three of these were hopeless cases, and ought not to have been operated on. The proceeding, however, has not been so successful in other hands, and further experience is needed to show its real value and the indications for its performance. Attempts have been made in tumours which are pedunculated—and which, therefore, are less likely to contain the cord or nerves—to obliterate the neck by the gradual pressure of a clamp, and such tumours have even been successfully removed.[4] It must be left to the surgeon's own judgment whether he thinks it justifiable to risk this last resource. The pedunculated condition of the tumour and its high position are doubtless favourable circumstances for the success of the attempt. Yet it might be argued that such tumours would very probably remain inactive. I have never but once performed the operation myself, and then on a tumour in the loins, in the case of a girl æt. 8, whose life was rendered intolerable from permanent



Fig. 232. Spina bifida, taken from a child who died a fortnight after birth, the immediate cause of death being sloughing of the parietes of the sac. The arches of the three lower vertebræ and part of the sacrum are deficient. The cauda equina passes into the tumour, and some of the nerves are spread out upon the inner wall of the sac, whilst others intersect its cavity.—St. George's Hospital Museum, Ser. v. No. 54.

[1] Solly, 'Med.-Chir. Trans.' vol. xl. p. 19.

[2] Sir A. Cooper, 'Med.-Chir. Trans.' vol. ii.

[3] 'The Treatment of Spina Bifida by a new method.' Glasgow, 1877.

[4] Wilson, in 'Path. Trans.' vol. xiv. p. 214. Several other cases have been since recorded. I may refer to two recently operated on at Leeds, and reported in the 'Brit. Med. Journ.' Dec. 30, 1882, p. 1297, by Mr. Robson, and April 14, 1883, p. 719, by Mr. Jessop.

paralysis of the sphincters; but spinal meningitis soon set in, and proved fatal by opisthotonos.

I ought to add that there are tumours which may be mistaken for spina bifida. I have seen a fatty tumour allowed to grow to an enormous size, under the idea that, being situated in the middle line of the spine, it was a spina bifida; but this was only for want of careful examination. But congenital subcutaneous tumours, when situated exactly in the middle line, may lead to greater difficulties.[1] In almost all spina bifida tumours, however, the sac swells up when the child cries, and the edges of its aperture can be felt when it is flaccid. Some malformations are classed with spina bifida in which the whole spinal laminæ are deficient, and others in which the ventricles and the central spinal canal are distended, and the substance of the cord spread over the sac; but they are of little practical interest, being incompatible with life.

[1] See T. Smith, in 'St. Bartholomew's Hospital Reports,' vol. ii. p. 25.

CHAPTER XXV.

DISEASES OF MUSCLES AND BURSÆ.

Rupture of muscles and tendons.

MUSCLES are liable to rupture from injury such as occurs not unfrequently in the pectoral muscle when a man in falling grasps at a bar and suddenly brings the whole momentum of his body to bear on the flaps of the axilla; or from over-exertion, as is common in the gastrocnemius;[1] or from spasm, as occurs sometimes in the rectus abdominus in cases of tetanus (see page 60). The usual seat of rupture is at the junction of the muscle and tendon, but it very commonly also takes place in the centre of the muscular belly, as is seen in the pectoralis major and the biceps flexor cubiti.[2] The diagnosis is easy when the accident is recent, from the hollow which replaces the natural outline of the muscle; but when the injury is of some standing, and the seat of rupture has been filled up with the products of inflammation, it is very difficult to distinguish it from some form of innocent tumour.

The treatment consists in relaxing the muscle by some apparatus which will bring its two ends nearer together, and by careful and even bandaging, in order to push the muscular fibres downwards and diminish the gap. The prospects of ultimate recovery in the case of the gastrocnemius, which is the muscle most commonly the seat of this injury, are good. Hunter, we are told, 'did not confine himself to bed for this accident, but continued to walk about during the cure. His mode of treatment was to keep the heel raised, and to compress the muscle gently with a roller, by which any fresh separation of the ends of the tendon by spasmodic or involuntary contraction was prevented, for he found that by no *voluntary* impulse could he excite them to contract after the rupture of their tendon. . . . It was ascertained at Mr. Hunter's death that the union of the ruptured tendon was by ossific deposition.'

Another not unfrequent injury of muscles is where the sheath is more or less torn and the muscle displaced to some extent from its bed, a lesion sometimes spoken of as 'dislocation' of the muscle. We meet not very uncommonly with the partial form of this injury, but the complete, in which the whole belly of a muscle has been displaced, is far less common. The treatment consists in careful replacement as far as possible at the earliest moment after the injury (under anæsthesia if necessary), and careful position, bandaging and rest for about a month.

Dislocation of tendons.

This seems the best place to speak of an injury which is sometimes met with in other parts of the body, but much more commonly at the ankle than elsewhere—viz. dislocation of a tendon from its groove without injury to the tendon itself. The dislocation is either produced at once, or a previous sprain has somewhat loosened its connection with its sheath, and it gives way altogether in a second accident. The peroneus longus is far more commonly dislo-

[1] John Hunter ruptured the tendo Achillis in dancing, at the age of forty.—Hunter's Works, vol. i. p. 34.

[2] In some cases it is probable that only the fascia covering the muscle may have been torn, allowing the fibres to protrude through the rent when the muscle acts, but not involving any actual lesion of the muscle itself.

cated than any other tendon: but the peroneus brevis and the tibialis posticus have also been found to be displaced, and Sir J. Paget [1] alludes to three cases in his experience in which the extensor tendon of the middle finger has slipped over the heads of the metacarpal bone and first phalanx (an accident I have myself witnessed), as well as to a preparation in the Museum of St. Bartholomew's Hospital of the long tendon of the biceps dislocated from its groove. When the tendon is superficial, the signs of the injury are evident. The peroneus longus tendon, for instance, or the extensor tendon of the finger, may be distinctly traced, and may be slipped back to its proper position, on relaxing the parts. Dislocation of the deeper tendons, such as that of the biceps, is probably (as Sir J. Paget believes) an injury whose precise nature could hardly be verified; and, in fact, there is still much controversy on the subject (see p. 262). When the nature of the case can be ascertained the tendon should be replaced, and confined in position by a pad or other appropriate apparatus; but it often remains loose for an indefinite time—at least, this seems to be the case with the peroneus longus. My patient, who had the extensor tendon of a finger displaced, soon completely recovered.[2]

Inflammation of muscles.

Inflammation of muscles, as far as it can be distinguished from that of other parts, occurs usually in the course of rheumatism or syphilis. The 'gummatous' tumours which form in the later secondary, or tertiary stages of constitutional syphilis, may often be recognised in large muscular masses, such as the gastrocnemius or the scapular muscles, forming rounded, hard, movable tumours, which are painful, especially at night, and are very slow in their progress. They show very little tendency to suppurate. They are usually quickly removed by a course of iodide of potassium, perhaps assisted by iodine externally.

Inflammation of tendons.

The sheaths of the long tendons of the forearm are often found inflamed after excessive exercise—as after a hard day's rowing—forming a long sausage-shaped swelling, inflamed and tender, and giving a peculiar creaking sensation to the finger when the muscle acts and sets in motion the lymph contained in its sheath ('ténosinite crépitante' of French authors). This inflammation usually subsides rapidly by rest and the application of iodine.

Whitlow.

Whitlow is a popular name given to inflammation in or in the neighbourhood of the sheath of one of the flexor tendons of the fingers. Surgically speaking, however, there are various forms of this disease. The common whitlow, or paronychia, consists usually of a collection of purulent fluid between the skin and epidermis ('phlyzacious pustule,' as it is sometimes called), and requires nothing but the division of the epidermis and a little common dressing. In other cases abscess forms below the skin, and should be early opened. This, however, involves no danger to the finger. But the acute inflammation inside the sheath of the tendon (paronychia tendinosa, or periosteal whitlow) is a very serious disease, and is too often, through the mismanagement of ignorant persons, permitted to go on to the destruction of

[1] 'Clin. Lect. and Essays,' p. 86.

[2] A large number of cases and references bearing on this subject are collected in an interesting little pamphlet, entitled 'Surgical Cases read before the Boston Society for Medical Observation,' by Dr. H. H. A. Beach, Cambridge, U.S., 1876. See also a very interesting clinical lecture by Mr. Callender on 'Dislocations of Muscles,' 'Brit. Med. Journ.' July 13, 1878.

the finger or even of the hand. It arises usually after a punctured or poisoned wound, sometimes without known cause, as a deep-seated and very painful swelling, generally in the middle phalanx of the finger, with very little redness, and with a very slight amount of swelling compared to the pain, which is often so violent as to prevent the patient from sleeping. The part is exquisitely tender; it is too tense for fluctuation to be felt, but matter will almost certainly form in a very short time, and an incision is urgently needed, whether suppuration has or has not taken place. The relief to the pain and tension afforded by a free and deep incision in the middle line of the finger is decisive and immediate; and if the incision be made before the abscess has formed, so much the better for the integrity of the part. If, on the other hand, it is delayed, the inflammatory effusion will separate the tendon from the vessels which supply it, and cause sloughing of the tendon; or suppuration will penetrate the periosteum, producing necrosis of the phalanx, or may even burrow backwards into the palm of the hand and destroy the whole function of the member.[1]

The incision is very painful, although the pain is only momentary, and therefore an anæsthetic may be given, especially as it renders it easier to incise the parts with the requisite freedom. The bleeding should be encouraged by putting the hand into warm water. Afterwards the hand should be elevated on to the opposite shoulder and a large poultice applied.

Housemaid's knee.

The most common of all the diseases of bursæ is that enlargement of the bursa patellæ which is popularly called 'housemaid's knee,' inasmuch as women of this class are most liable to it, from the irritation of constant kneeling in their work. It is, however, by no means confined to housemaids nor entirely to the female sex, though men are rarely the subjects of it. The disease is also sometimes caused by injury with extravasation of blood into the bursa. In either case the effusion must be referred to inflammation, though frequently of so low a type that no inflammatory appearances are perceptible. It forms a prominent rounded tumour, covering the lower part of the patella, and in contact below with the capsule of the joint, usually too tense to allow of the feeling of fluctuation, though in other cases this may be perceptible. There is generally no pain or inconvenience at first, except the obstruction which the swelling causes to kneeling; but afterwards, from persistence in following the occupation, acute inflammation often comes on with great swelling, œdema, and redness extending around the joint, much pain, rigors, and other feverish symptoms. Such cases are occasionally mistaken for abscess in the joint; but the buried condition of the patella shows that the greater part at least of the abscess is external to the articulation, and though it is no doubt possible for a bursal abscess to make its way into the joint, yet it very rarely happens. Such abscesses should be early and pretty freely opened. It is a good plan to make an incision in front, then pass in a director and cut down on its point on either side of the cavity, so as to ensure a depending opening on either side. Bursal abscesses, as far as I have seen, almost always do well.

Bursal abscess.

Bursitis, or bursal enlargement.

The ordinary chronic enlargement consists at first merely of the bursa, filled with a fluid much resembling synovia, and containing small portions of fibrine; at other times more or less blood is mixed with the fluid. As disease progresses the walls of the bursa thicken, the portions of fibrine in

[1] See two cases recorded by Mr. Tatum in 'Syst. of Surg.' 2nd ed. vol. iii. p. 648, in both of which amputation of the forearm became necessary.

the fluid increase, forming a number of 'millet-seed' bodies, which can sometimes be felt creaking in the sac when it is handled. As the thickness of the walls increases, the cavity becomes encroached upon—though the tumour may increase in size also—and sometimes the cyst is converted into a solid fibrous tumour. Far more commonly, however, a small cavity containing small lumps of fibrine or altered blood will be found at a very advanced period of the disease; and even when the tumour is solid throughout, its centre will be observed to be much softer and more succulent than its circumference (see Fig. 154, p. 382).

At its commencement the disease is very amenable to treatment. Perfect rest, with slight counter-irritation, as by tincture of iodine or a blister, repeated from time to time as may seem necessary, will remove the swelling; in fact, I have seen many of these bursæ subside altogether by simple confinement to bed. If the cyst is large, but not thick, there is no objection to drawing off the fluid with the aspirator, and then strapping the part; or if the fluid re-collect applying a blister. When the sac is very thick these means will not succeed. A seton kept in till it causes suppuration will produce the obliteration of the cavity, and the thickening will to a great extent subside, but not entirely. After the seton an irregular cicatrised mass will be left, disagreeable to kneel upon. Besides, the treatment is painful and not free from danger. Incision is necessary when suppuration is clearly present, and is quite justifiable when it is only suspected. If no pus is found the sac is evacuated, and will probably fill up by granulation. Incision and pressure is a very valuable plan of treatment in many cases, much less dangerous and painful than the seton, and often likely to obviate the necessity of removal when the walls are even of considerable solidity. It is warmly advocated by Mr. Savory,[1] who, indeed, says 'it may be adopted in almost every case.' It consists merely in puncturing the enlarged bursa with a lancet or small knife at its most prominent part, evacuating its contents, and bringing the walls together as accurately as possible with strapping. The patient need not be confined to bed, though this is in my opinion desirable. Sometimes the cyst does not refill. If it does it must be again punctured, and will then usually suppurate, when a poultice is advisable. The thickened walls melt down in the suppuration, and when the wound closes only an ill-defined hardness is left. The pressure of the strapping should be kept up in cases which do not suppurate for a week or a fortnight after the cure appears complete. But when the walls are much thickened, the total removal of the tumour is the most advisable course. It can hardly be denied that the operation involves some risk; but this cannot be great, for I have removed many such tumours and seen many others removed, and never heard of any bad consequences.[2] The surgeon will remember that the lower part of the tumour is in contact with the capsule of the joint. A free incision is to be made from top to bottom over the middle line of the tumour and the skin fully dissected back on both sides. Then the upper portion of the tumour is separated from the periosteum of the patella, and in removing the lower part from the capsule of the joint care is taken to put on the stretch the cellular adhesions which fix

[1] 'St. Bartholomew's Hospital Reports,' vol. ii. p. 79.

[2] Mr. Erichsen speaks of the occasional occurrence of abscess spreading into the ham, which he attributes to the layer of deep fascia having been divided, which, after surrounding the knee, is fixed to the borders of the patella. 'Sc. and Art. of Surg.' 5th ed. vol. ii. p. 250. I have never seen this complication, but it furnishes another motive for carefully keeping the edge of the knife on the tumour during the dissection.

it and divide them with the edge of the knife turned *towards* the tumour. In this way it is impossible to wound the joint. The wound is to be strapped up carefully, and the limb put on a splint and carefully bandaged from the foot upwards.

Affections of various bursæ.

Numerous other bursæ exist in the normal condition, or are developed from constant friction between the skin and an underlying bone. There is one on the anterior aspect of the upper end of the tibia, between the tubercle of the tibia and the ligamentum patellæ, which is occasionally, though rarely, found enlarged; one over the olecranon, which is peculiarly apt to enlarge in miners, from the attitude in which they constantly work, and is therefore denominated 'miner's elbow'; and several in the popliteal space,[1] one of which, that beneath the tendon of the semi-membranosus muscle, is comparatively often enlarged, and when it shares the pulsation of the popliteal artery has been mistaken for aneurism, though such a mistake can only be accounted for by carelessness. The bursa under the tendon of the psoas is another instance in which a natural bursa is occasionally enlarged. The subject has been treated of in reference to the diagnosis of hip-disease on p. 478. None of these bursal enlargements (if we except the last) are difficult of diagnosis to one who remembers their position and the fact of their occasional diseased condition. But if any hesitation is felt as to the nature of the tumour the grooved needle will solve the difficulty at once. These enlarged bursæ must be treated in the same way as housemaid's knee, by blisters, iodine injection, or incision. And if they suppurate, as some are very prone to do, especially that over the olecranon, they should be laid pretty freely open. Suppuration in this bursa often produces a diffused inflammation extending down the forearm, which is sometimes mistaken for phlegmonous erysipelas, but which really requires no treatment beyond the free evacuation of the bursal abscess.

In treating the bursæ which are comparatively often found in the popliteal space the surgeon must remember that those at the outer side of the ham almost always communicate with the joint, and that beneath the tendon of the semi-membranosus not unfrequently does so. Great care, therefore, is necessary to examine the limb in various positions, in order to ascertain whether this is the case before any active treatment is undertaken. The communication, if it exists, can generally be opened by flexing the knee, and then some or all of the fluid in the bursa can be pressed back into the joint. When this is the case no operation is admissible. When the bursa does not appear to communicate with the joint, if the patient suffers much inconvenience from the presence of the tumour, and external applications with rest have failed to cure it, it will be justifiable to inject it with iodine, or to put a fine seton through it.[2] But such bursæ often exist and attain a large size without giving the patient any trouble. I saw a man once who had been for more than ten years an able seaman in Her Majesty's navy, and who had never suffered in the least from the presence of the bursa, though it was unusually large.

Bursæ of new formation are found over the displaced bones in clubfoot, over the end of the fibula in tailors, and in many parts of the body subject to pressure; and accidental or irregular bursæ are met with in various parts—e.g. over the hyoid bone or larynx—but they seldom grow to a size requiring any serious treatment.

[1] For an account of the normal anatomy of these bursæ see Gray's 'Anatomy,' 10th ed. p. 416.

[2] On the frequent connection between such bursæ and the joint, see p. 452.

Bunion.

A bunion is a bursa formed over the half-dislocated phalanx of the great toe from the pressure of the boot. It is often followed by destructive disease of the joint. But it does not always (at least at first) communicate with it. When the affection is confined to mere inflammation of the bursa, rest and soothing applications will probably subdue it, and its recurrence must be obviated by some change in the shape of the boot. If it suppurates it is better to allow it to burst without interference; but if the matter will not come to the surface it must be incised, and then if it does not seem to communicate with the joint its interior may be rubbed with lunar caustic or the strong nitric acid, in order to procure its obliteration. If the joint is involved, the shortest and, on the whole, the best course for the patient is to amputate the toe, though if the patient wishes it there is no objection to the resection of the diseased joint. It is doubtful, however, whether this operation, even if successful, will leave the foot more useful than after amputation of the toe.[1]

Ganglion.

Ganglion is the name given to an enlarged bursa which is developed in connection with one of the tendons. Such bursæ are most common on the back of the wrist, on or near the extensor secundi internodii pollicis, though they are not rarely developed in other tendons. The exact connection of the sac with the tendon does not seem to be quite clearly ascertained. It forms a small, hard, round swelling at the back of the joint, and the main symptom which it causes is weakness of the wrist and hand, sometimes to an extent which is hard to reconcile with the apparent triviality of the affection. It has been clearly proved that, in some cases, at any rate, a ganglion owes its origin to a protrusion of the synovial membrane of the wrist or carpal joints,[2] and this is probably often, if not always, the nature of those ganglia which present deep in the wrist under or close to the radial artery; but that the more superficial and movable ones are formed in the same way is at any rate unproved. Nor is it proved or probable that as a rule they have any open communication with the sheaths of the tendons, though they are believed to be often developed by an outgrowth from them originally, the communication between which and the sheath of the tendons has become obliterated.

A ganglion almost always contains a clear gelatinous fluid exactly resembling thin jelly.

The treatment consists in freely dividing the ganglion subcutaneously, squeezing out the contents, and applying pressure. The old rough method of bursting the sac by the blow of a book or by forcible pressure was essentially the same, but it is far less certain, more painful, and is besides excessively rough and unsurgical. It is far better to pass in a tendon-knife at a little distance from the small round lump, apply its edge fairly to the side of the tumour, and cut the sac across as freely as possible. Then all the contents of the sac are to be squeezed out—whether through the puncture or into the cellular tissue does not matter—and pressure is to be applied by means of a piece of sheet lead, or other firm substance, carefully strapped on to the remains of the sac. This method succeeds in the great majority of cases, but in some the tumour refills even after it has been subcutaneously divided with

[1] I am speaking of cases of old semi-dislocation with inflamed bunion, where the bones are often much altered in shape, and the tendons rigid. In ordinary disease of the metatarsophalangeal joint, there is no doubt that excision leaves a most useful foot.

[2] There is a preparation in the Museum of St. George's Hospital showing such a communication in a case of ganglion. See also Nélaton, 'Path. Chir.' vol. v. p. 905.

all possible care many times. Such cases may usually be cured by a seton of two or three threads run through the sac, and kept in till suppuration is set up, when it can be withdrawn. If this also fails the choice is between laying the ganglion open and dressing in the cavity till it fills up, or dissecting it out. The former plan is the one which I prefer. It is I believe almost always successful, and with antiseptic precautions involves very little danger. The sac should be carefully emptied of its contents, and it will sometimes be found that the failure of the previous treatment was due to the pressure of millet-seed bodies in the sac.

Compound palmar ganglion.

The compound palmar ganglion is a tumour or cyst developed in the sheath of the common flexor tendons passing under the annular ligament of the wrist. It forms a tumour which presents in the forearm and in the palm extending on both sides of the annular ligament which binds down its central part; and often, on making the patient move his fingers, a creaking sensation is perceived, caused by the 'millet-seed' bodies which are found in it. These are small masses of lymph, often very numerous, which are almost always contained in these compound ganglions. The wrist is very much limited in its movements in these cases, and some of the fingers also are sometimes entirely deprived of motion, flexed into the palm, and utterly useless. The main obstacle to the cure of the disease is the presence of the millet-seed bodies; when these are evacuated the case generally does well. I have never hitherto seen a case of this disease in which any progress to cure was made until these bodies had been evacuated, and I have now given up as useless any attempts to cure it by blisters or injections. The best plan is to make a limited incision into one part of the tumour (that in the forearm is usually selected); and press out all the millet-seed bodies, emptying the sac as completely as possible. Strapping should be applied methodically from below upwards, so as to keep the parietes of the sac as closely as possible in contact, in the hope that they will close and that no further inflammation will occur. In all the cases, however, that I have seen, suppuration has taken place; but this has not interfered with the ultimate success of the treatment. Unless the suppuration is unusually violent or some complication should occur, the prognosis is good, and the patient generally recovers the entire use of the hand and fingers.

Degenerations of muscle.

Muscles are subject to various degenerations, some of which constitute definite and important surgical affections; others are rather the consequences or accompaniments of disease, or are mere pathological curiosities. The

Simple atrophy.

atrophy which follows on disuse requires no further notice—the muscle is merely smaller, but without any change in the anatomical structure of its fibres. Clearly contrasted with this is the 'progressive muscular atrophy'

Progressive muscular atrophy.

of Cruveilhier, in which, from some general cause which is not at present completely understood, the muscular tissue in one or more regions becomes, without any known injury or other reason, wasted—the wasting extends during an indefinite period, involves fresh groups of muscles, and may go on till the patient's death. The disease is often hereditary, and it affects usually the male members of the family. In other cases it has been thought to be excited by cold and damp, or by syphilis. Cruveilhier believed that the disease depended on degeneration of the anterior or motor roots of the spinal nerves; but this seems contradicted by the result of post-mortem examination in many cases where no such lesion existed. Dr. Lockhart Clarke believes that the essence of the disease consists in 'lesions of the grey substance of

the cord,' consisting chiefly of areas of what he calls 'granular and fluid disintegration;' and other pathologists have supported this statement,[1] which is rendered still more probable by the fact that symptoms identical with the hereditary affection have been noted in cases of obvious disease of the spinal cord. It is probable, therefore, that the disease should be classed with those of the nervous centres; yet, as this is not yet absolutely proved, it is generally still assigned to those of the muscles. It commences most commonly in the upper extremity, and usually with wasting of the muscles of the palm, spreading upwards to those of the arm, chest, abdomen, and lastly to those of respiration and deglutition. More rarely it begins in the thorax, and still more rarely in the lower limbs. The weakness is accompanied by a loss of co-ordination, producing uncertainty in the movements, with cramps and twitches in the part. Sensation is usually unaffected. Occasionally there is some numbness, and pain is complained of in the affected muscles in about half the cases. The wasting does not involve the whole muscle. On microscopic examination, side by side with the wasted fibres are seen others which are perfectly natural, and the same is the case to the naked eye. The atrophy is accompanied by granular or fatty degeneration of the muscular tissue, the sarcous elements being replaced by granules or fat-cells, while the striæ have become more or less indistinct. In other cases a rarer degeneration is found—the *waxy* or *vitreous*—in which the fibres are changed into a transparent homogeneous substance, in which no striæ can be seen, and the muscle resembles a piece of tendon or aponeurosis.

The treatment of this disease is rarely satisfactory. Strict attention to the general health, the treatment of any syphilitic taint which may be present or be suspected, the prolonged use of galvanism in its various forms, and the use of the warm sulphurous water of Aix-la-Chapelle, appear to be of admitted value. Medical treatment may succeed in some cases, and if so the drugs which are most likely to be of value are arsenic, phosphorus, and the mineral tonics, as zinc or iron. But to be efficacious these remedies must be long continued, in small doses. Dr. Lockhart Clarke suggests the trial of counter-irritation to the spine.

Besides these two well-marked forms of atrophy there are others in which the atrophy of disuse is variously combined with fatty or granular degeneration 'in acute diseases, alcoholism, lead-poisoning, rheumatism,' &c.; but as this is merely a subordinate feature of the general disease, nothing further need be said about it.[2]

Infantile paralysis.

Two forms of degeneration of muscles in childhood claim notice here. 1. Infantile paralysis, or 'essential' paralysis, so called because it is not supposed to be connected with any morbid state of the nervous centres. We may fairly reserve our opinion on the latter point. No proof has, it is true, been obtained hitherto that the spinal cord is affected in infantile paralysis;[3] yet the symptoms point strongly to disease either of the cord or nerves as the cause of the paralysis which so speedily occurs in a muscle or group of muscles. The

[1] See Charcot, 'Lectures on Diseases of the Nervous System,' New Syd. Soc. Trans. lect. iii.

[2] I do not speak here of 'locomotor ataxy,' regarding it as lying more in the province of a treatise on medicine; and I apply the same observation to trichiniasis.

[3] Charcot, however, has recently taught, as the result of his own researches and those of other eminent pathologists, that there is in this disease atrophy of the motor cells in that portion of the cord from which the affected parts derive their nerves. See Charcot, 'Lectures on Diseases of the Nervous System,' New Syd. Soc. Trans. p. 57.

disease begins usually after a feverish attack, or sometimes during teething, after convulsions, and in some cases without any noticeable derangement of the general health. The muscular affection, whether preceded by general ill-health or no, is in itself sudden. It usually affects the lower extremities, and either the whole limb or groups of its muscles, or a solitary muscle may be affected. Less commonly it is noticed in the upper extremity. The muscle which is most commonly affected alone is, I think, the deltoid. The sterno-mastoid is also sometimes alone affected. When special groups of muscles of the leg are paralysed the corresponding form of clubfoot follows from the unbalanced action of their antagonists. Paralysis affecting the muscles of one buttock sometimes leads to a suspicion of hip-disease, but is easily distinguished from it, on attentive examination, by the perfect freedom and painlessness of passive motion.

When the disease is inveterate nothing can be done except to restore the limbs by tenotomy and mechanical appliances to such a position as may be most useful to the patient, if he has the power of using them in any degree. But in early cases a cure may fairly be hoped for from the persistent use of galvanism, from exciting the muscles to voluntary action as far as is possible,[1] from tonics, such as strychnia, and from shampooing or rubbing the limbs.

2. The other form of paralysis in childhood is that curious disease called 'pseudo-hypertrophic paralysis,' or 'Duchenne's disease.' The subjects are as a rule more or less idiotic. After a stage of partial paralysis, or weakness of the lower limbs, which may last several months, the patient being quite unable to stand or walk, the stage of hypertrophy commences, in which the gastrocnemii, the gluteal muscles, and those of the loins, become very much swollen. The swelling, however, or apparent hypertrophy, is found to be due not to any real hypertrophy of the muscle, but to an abundant formation of connective tissue or fat, or both, amongst its fibres, which are themselves at least at first healthy and present the normal response to galvanism. In the third stage (which may be deferred for years after the commencement of the second) the limbs begin to waste, complete paralysis ensues, and the patient dies sooner or later, unless some accidental malady carries him off.

'During its first stage the disease is sometimes curable. Duchenne has recorded two such cases.[2] But in the second stage scarcely any hope of recovery can be entertained. The treatment consists chiefly of local faradization and shampooing.'—Lockhart Clarke.

Tumours of muscle.

Muscles are subject to all the forms of tumour described in Chap. XVII., but I do not know that their occurrence in muscles is a fact of any special significance. I have spoken on p. 342 of the singular cases in which muscles ossify, or where loose bony tumours are found to be developed in them. The gummatous tumours due to syphilis sometimes attain an enormous size, and in one well-known case[3] the scapula was removed for such a growth. They are, however, almost always amenable to internal remedies.

[1] Much good often results from putting the child in a 'go-cart,' where in order to move about, the affected muscles must be called upon to act.

[2] 'De la Paralysie musculaire pseudo-hypertrophique.' Paris, 1868.

[3] South, in 'Path. Trans.' vol. vii. p. 346.

CHAPTER XXVI.

CLUBFOOT AND OTHER DEFORMITIES.—ORTHOPÆDIC SURGERY.

THE various deformities which are treated of in this chapter, and of which clubfoot may be taken as the type, as it is also by far the most frequent example, are due to shortening of the muscles, the result either of the relaxation of their antagonists from paralysis, of a tonic spasm in their own substance, or of some change in the structure of the muscular fibres, leading to their permanent contraction.[1] It is very difficult, indeed, to determine the share which paralysis or spasm respectively may have in producing the congenital forms of the malady, but in many of the non-congenital cases the deformity clearly depends on infantile paralysis. Congenital cases, on the other hand, seem more of a spasmodic nature, though the spasm relaxes to a great extent in sleep or in yawning,[2] and they are accordingly generally believed to depend on some abnormal state of the nervous centres, though what that state is remains unknown. The cases in which deformity is produced by disease of the muscles themselves irrespective of spasmodic or paralytic deformity, are purely exceptional. The main point to determine in the treatment of deformities is their curability by or without surgical operation. The milder cases of deformity, whether spastic or paralytic, may be remedied by gradual extension by means of appropriate apparatus, and some even by the manipulations of the nurse or mother; but for cases of ordinary severity tenotomy is required before the application of the instrument intended to place the parts in the natural position.

Tenotomy.

Tenotomy, or the subcutaneous division of tendons, is an operation now very extensively practised, but for which the surgical profession is indebted to the genius of a surgeon lately deceased—the illustrious Stromeyer.[3] It consists in passing a small thin knife through a minute puncture close to the contracted tendon, dividing it, if possible, without injuring any part in its vicinity; then withdrawing the knife, closing the wound carefully and allowing it to heal, which in almost all cases it does by the process of first intention. The upper end of the divided tendon retracts in its sheath, and the sheath becomes filled with lymph, in which fibrous tissue is developed, very much as

[1] This change is called by American surgeons 'contracture,' and is chiefly exemplified by the state of the muscles on the flexed side of a permanently contracted joint, as the hip or knee.

[2] See Dr. Little's observations on this head in 'Syst. of Surg.' 3rd ed. vol. ii. pp. 227 et seq.

[3] Dr. Adams says: 'On Feb. 28, 1831, Stromeyer first divided the tendo Achillis by subcutaneous puncture in a case of non-congenital equinovarus in a boy aged nineteen. No inflammation followed. By gradual extension the deformity was cured in two months, and the boy allowed to walk with a steel support to the boot.'—'Rust's Magazine,' 1833, vol. xxxix. p. 195. But though Stromeyer's priority in the practical use of tenotomy is undisputed, the priority in the suggestion is due to Delpech, as Stromeyer has expressly pointed out. John Hunter, after he had suffered in his own person from rupture of the tendo Achillis (see p. 495), investigated the process of union after subcutaneous division of the tendo Achillis in dogs, and his preparations are still in the Museum of the College of Surgeons. He came to the perfectly correct conclusion that the process 'was similar to that of fractured bones where the skin is not wounded.' In fact, Hunter may, as Mr. Adams has said, be regarded as the originator of subcutaneous surgery.

a simple fracture is united. This fibrous tissue is at first soft, and easily yields to an extending force (Fig. 233); and the subsequent treatment consists in gently drawing it out to the required length. When this process is completed the uniting material is thinner than the natural tendon, and the muscle comparatively weak; but it gradually acquires strength and breadth, and when examined some time afterwards so closely resembles the original tendon [1] that the difference is only visible on a fresh section, and after very close examination. Sometimes after division one or both ends of the divided tendon may adhere to a neighbouring bone and the function of the divided muscle may thus be lost, at any rate for the time. Still it seems that these adhesions often give way ultimately, and the muscle resumes its functions; and even if not, the limb will probably be very useful. The tendo Achillis, which is the most important of the tendons usually divided, lies too far away from the tibia to be subject to this accident.

In other cases the tendon, if divided near its insertion, may form for itself an entirely new attachment, as was the case in the instance from which Fig. 234 was taken. But

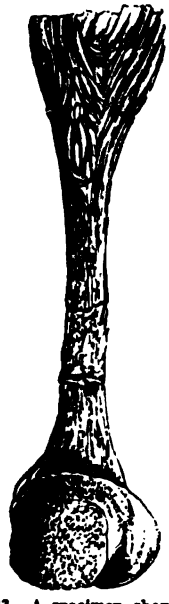


FIG. 233. A specimen showing the condition of the tendo Achillis in an adult 22 days after its division. The operation had been performed in order to assist in the reduction of a compound fracture of the leg. Amputation became necessary at the above period.—From St. George's Hospital Museum, Ser. iv. No. 20.

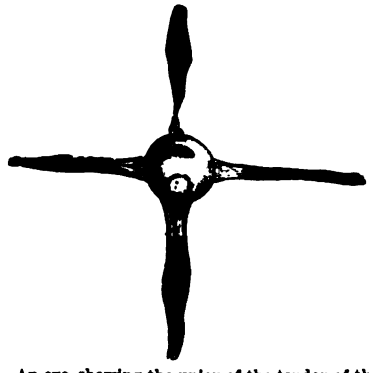


FIG. 234. An eye, showing the union of the tendon of the external rectus muscle, after its division in a case of squint. The patient died of phthisis a month after the operation. The muscle (which is seen at the upper part of the figure) is now connected to the sclerotic by a long thin bundle of fibrous tissue. The insertion of the original tendon into the tunica albuginea is perfectly distinct, and appears quite separate from the new uniting material. The latter was so firm that it allowed of forcible traction without giving way. The deformity appeared to be cured.—St. George's Hospital Museum, Ser. iv. No. 7.

in such a case the operation will probably be as successful as if the two ends of the tendon had been united in the ordinary way.

I mention these irregularities in the method of union inasmuch as they have been made the ground for decrying the operation of tenotomy altogether, except as applied to the tendo Achillis, and for substituting extension for it as the general method of treating clubfoot.[2] Mr. Barwell is impressed with the belief that after the division of the tibialis posticus and other deeply seated tendons the tendon often does not unite in its natural relations, and that a lameness is left—'less apparent, perhaps, but certainly more incurable than the original disease.' I can only say that after the appearance of Mr. Barwell's

[1] The process of union in divided tendons has been most minutely described by Mr. W. Adams, 'On the Reparative Process in Human Tendons after Division.' I would refer the reader to the 4th chapter of that work for many details for which space fails me here.

[2] Barwell, 'On certain Grave Evils attending Tenotomy, and on a New Method of Curing Deformities of the Foot.'—'Med.-Chir. Trans.' vol. xlv. p. 25.

paper I have carefully examined many cases under my own and other surgeons' care in which these tendons have been divided, and have failed to verify Mr. Barwell's statement. The foot, in favourable cases, is very nearly natural. Beyond some flattening of the arch and widening of the sole, there is little change in its external appearance, and the patient walks nimbly and with no perceptible limp. Nor is Mr. Barwell's method of extension, by means of indiarubber cords, hooked on to splints which are kept in place by plaster, at all easy to apply successfully in cases where the deformity is serious, since the traction necessary to correct the deformity will either pull the splints off or, if they are more securely fastened by the strapping, the latter will then cut into the skin. My own trials of this method have consequently been disappointing; yet its principle, that of substituting gradually increasing elastic tension for the muscles which are paralysed, is so obviously sound for the treatment of paralytic deformity, that I thought it right to direct the reader's attention to it. I consider it a valuable method of treatment in the slighter cases of paralytic deformity, though Mr. Barwell's statement of the evils attending tenotomy seems overdrawn, and tenotomy is still in general use in all ordinary cases.

Tenotomy is generally employed in the cure of clubfoot; sometimes, as in the case from which Fig. 233 was drawn, to facilitate the reduction of a fractured bone, sometimes of a dislocation; also for squint and wryneck, and in various deformities, as those produced by diseased hip, knee, &c. Muscles also are occasionally divided, either subcutaneously or otherwise, in plastic operations, as the levator palati mollis in staphyloraphy. In all these cases the object of the surgeon is to divide the tendon or muscle as cleanly and with as small a wound as possible; and, if the operation be subcutaneous, to keep the parts quiet until primary union is ensured. The attempt to put the parts at once into the desired position after subcutaneous tenotomy may, indeed, be successful, but it is somewhat risky, for suppuration may easily follow, and then time will be lost instead of gained; or the divided tendon may be matted to the parts around, and the attempt to cure the deformity prove an entire failure; whilst the slight delay in waiting for primary union does not increase the difficulty of treating the case at all, since the uniting medium is perfectly soft and extensible then and for a long time afterwards.

I now turn to the various kinds of clubfoot.

Talipes equinus.

Talipes equinus is the deformity produced by a contracted state of the gastrocnemius muscle drawing the os calcis directly upwards, and causing the patient to walk on the metatarso-phalangeal joints and the toes, the foot bearing a strong resemblance to that of a horse, whence the name. Figs. 235, 236, taken from an old neglected case of this deformity, will give a better idea of its anatomy than words can do. It will be seen that the heel-bone is drawn into a tolerably vertical position, the tarsus is much curved forwards, so that the metatarsus approaches the os calcis; and the muscles of the sole of the foot, with the plantar fascia, are very much contracted, the long muscles in front proportionally stretched, those on the inner and outer aspects of the foot not materially affected.

The cure of the deformity is to be sought in the elongation of the contracted gastrocnemius muscle. In very slight incipient cases this might perhaps be done by repeated manipulations and by the gradual traction of a splint of ductile metal applied in front, the angle being carefully changed till the foot is drawn up to and beyond a right angle.

Tenotomy offers a ready means of restoring the position of the foot, and experience proves that the muscle after its elongation may recover its functions sufficiently for all the purposes of ordinary life. So that if the deformity is at all strongly pronounced—that is, if the foot cannot be brought to a right angle, or on being released flies strongly back—it seems of little use to waste time on less effectual treatment. The tendo Achillis should be divided by turning the child on its belly and introducing the tenotome on the inner side below and as close to the tendon as possible, a short distance above the point of its attachment, where it seems thinnest, the foot being still extended. When the knife is fairly under the tendon the foot is to be strongly flexed by the assistant, while the surgeon, with a slight sawing motion, presses the knife's edge against the tightened tendon. As soon as it has been sufficiently divided the extending force will rupture it with an audible snap, when the knife should

Division of the tendo Achillis.



FIG. 234. A preparation of talipes equinus seen from the inner side. *a*, tibialis anticus; *b*, extensor proprius pollicis; *c*, extensor longus digitorum; *d*, skin, with contracted plantar fascia; *e*, tibialis posticus; *f*, tendo Achillis; *h*, tendon of flexor longus pollicis; *k*, flexor longus digitorum.



FIG. 236. The same preparation seen from the outer side. *a*, tibialis anticus; *b*, extensor proprius pollicis; *c*, extensor longus digitorum; *d*, flexor brevis digitorum; *e*, plantar fascia; *f*, tendo Achillis; *g*, *h*, peroneus brevis and longus; *i*, peroneus tertius.—From a preparation in St. George's Hospital Museum, Ser. iv. No. 22.

be instantly turned flat, so that the skin may not be cut, and should be withdrawn. If the operation has been dexterously performed hardly a drop of blood will escape. The wound should be strapped, and the foot placed on a splint in the extended position in which it was found before the operation. No attempt should be made to bring it to the natural angle till the wound is soundly healed, which will probably be the case in about five days. In complicated cases the division of the plantar fascia, and possibly of some of the muscles of the sole, is necessary in order to unfold the tarsus, as will be sufficiently seen from Figs. 235, 236.

Scarpa's shoe is to be applied when the wound is healed, in order to stretch the uniting material and elongate the muscle to the extent necessary to bring the sole of the foot flat to the ground. When this is done (which in a

favourable case may be in about two months) a boot with irons is to be applied, to prevent re-contraction, and if the child is old enough he may be allowed to walk.

Talipes varus.

The severer forms of talipes equinus, such as that represented above, are commonly congenital; and, as Dr. Little has observed, such cases of congenital equinus usually remain throughout life purely equinus—i.e. the foot is perfectly straight, without any material deviation to the inside or the outside. But the common form of congenital clubfoot is talipes varus, or equino-varus. In the pure T. varus the os calcis would be on the same horizontal level as the metatarsus; but if this is ever the case it must be very rare. In practice the os calcis is always found more or less elevated—i.e. the case partakes more or less of the essential characters of T. equinus. The term T. varus is usually applied to those in which the heel is not very much elevated; when it is so the deformity is named T. equinovarus; but in ordinary nomenclature they may be regarded as synonymous.

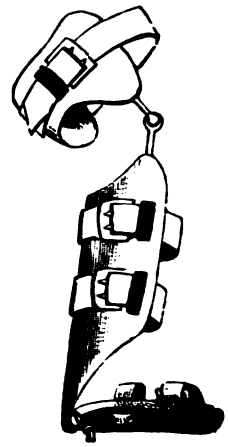


FIG. 237. Shoe for the treatment of simple talipes equinus in infancy.—From Holmes's 'Surg. Treat. of Children's Diseases.'

The deformity consists in a simultaneous contraction of the tendo Achillis and the tendon of the tibialis posticus, that of the tibialis anticus being also almost always contracted, and very often the flexor longus digitorum as well. The internal portion of the plantar fascia is also constantly found contracted; and this, if the deformity is inveterate, involves also the contraction of one or more, or all, of the short muscles of the sole.

The deformity of course increases the longer it is neglected. When the child begins to walk he rests on the outer side and partly on the dorsum of the foot, on which part large bursæ usually form. If the skeleton of the foot be examined (Fig. 238) in a case of old deformity, the ankle-joint will be found distorted, the fibula being drawn behind the tibia, the internal malleolus almost or quite in contact with the scaphoid bone, the astragalus pushed out towards the outer side of the dorsum, the cuboid bone turned downwards, so that its dorsal face supports the arch of the tarsus; the metatarsus, which is curved towards the calcaneum, is more or less vertical instead of horizontal. In old cases all the bones are changed in shape, and the ligaments, muscles, and fasciæ have also undergone corresponding changes. Such cases are, of course, incur-

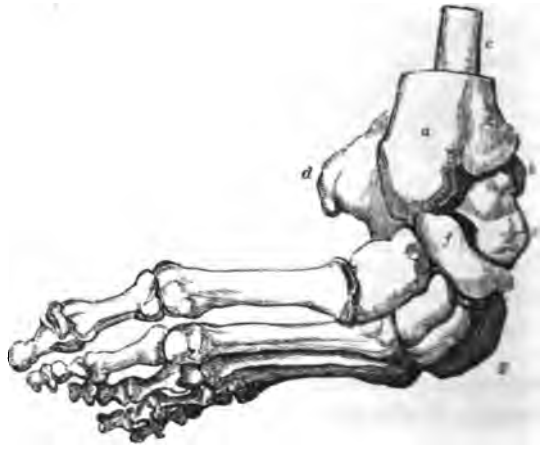


FIG. 238. Severe adult congenital varus, viewed from the front and inside; *a*, the tibia, cut down, in order to show the relatively posterior situation of the fibula; *b*, the external malleolus; *c*, the fibula; *d*, the posterior extremity of the os calcis drawn abnormally inwards; *e*, the astragalus unduly prominent on the dorsum of the foot; *f*, the navicular bone in contact with the internal malleolus; *g*, the cuboid, its posterior surface applied to the ground.—From Little, in 'Syst. of Surg.' vol. ii. p. 231; 3rd ed.

able; or, if the position of the foot is to be remedied at all, it can only be so by excising some of the deformed bones. But in early life, while the structures are yielding, and the parts have not undergone any irremediable change, a very useful foot indeed may be obtained. In all the cases of cure which I have seen, a certain degree of flattening of the sole remained, and the patient, if severely tested, would not have been able to run, hop, or leap from a height with the same force or security as one who had the natural arch and spring of the foot, but for ordinary locomotion there is often little to be desired.

The treatment by manual extension or by india-rubber bands or other mechanism may succeed in the slighter cases, but for cases of ordinary severity the section of the tendo Achillis and that of the two tibial tendons is commonly necessary. Very often also the plantar fascia and the muscles in the sole of the foot will require division.[1] Many surgeons prefer to divide the tibial tendons first, and to convert the deformity into one of simple equinus before dividing the tendo Achillis, and this is no doubt the better plan in the graver cases of the deformity, since the heel forms a firmer *point d'appui* for the instrument than if the great tendon has been divided. The operation of dividing the tendon of the tibialis posticus in a fat baby is not always an easy one, and several cases have occurred in which the child, having accidentally died soon after the supposed tenotomy, it has been proved by dissection that the tendon had been missed. The small size of the tendon and the depth at which it lies buried account for these mistakes. Another danger is that of wounding the posterior tibial artery, which lies close to the tendon in the leg. For this reason apparently some surgeons have practised the division of the tendon in the tarsus, but in the infant it is very difficult indeed to find it there. The sharp tenotomy-knife is to be introduced close to the posterior edge of the tibia,[2] about an inch above the ankle; and the fascia having been freely opened (including the sheath of the muscles), a blunt-pointed tenotome is substituted for it, and its edge turned towards the tendon. An assistant holds the foot inverted during this stage of the operation. Then he forcibly everts the foot, and as the operator raises his knife the tendon is felt to yield. If the operator believes that he has missed the tendon he must re-introduce his knife close to the bone, pass it somewhat more deeply, and repeat the previous manœuvres. It is very difficult in relapsed cases, where the tendon has been previously divided, to be sure whether it has been severed or no. The assistant often feels the snap of the divided tendon more plainly than the surgeon. If profuse bleeding and blanching of the foot testify to a wound of the posterior tibial artery, careful graduated pressure should be made on the wound, and the limb be neatly and firmly bandaged (but not too tight) from the toes upwards on a splint; and no extension should be made for at least a fortnight. The accident is believed to happen very often, but in only one case was it ever thought necessary to tie the artery afterwards, and then, it is believed, only in consequence of extension having been used too soon. The flexor longus digitorum is often divided at the same time as the tibialis posticus, either accidentally or purposely. Much has been said about the risk of loss of motion afterwards in consequence of the adhesion of the divided ends of the

Division of the tibial tendons.

[1] Dr. Geo. Buchanan of Glasgow has called attention to the necessity in many cases of clubfoot for a deep incision in the sole of the foot in order to unfold the contracted tarsus and metatarsus (see his 'Address in Clinical Surgery,' 1874, p. 24). A glance at Fig. 235 will show how the plantar muscles are contracted in these cases.

[2] If the edge of the tibia cannot be felt with the finger, the knife is to be inserted about midway between the anterior and posterior borders of the leg, and the bone is to be felt with the point of the knife.

tibialis posticus tendon to its sheath or to the bone; but Mr. Adams's dissections[1] have shown that such adhesion is not very common, and that when it occurs it does not by any means necessarily involve the loss of the action of the muscle, since the adhesion often stretches to an extent which allows the muscle considerable play; and I may add that I have examined patients in whom the action of this muscle seemed to have been lost, yet who had very useful feet. The tibialis anticus tendon is easily divided, as it passes in front of the ankle, by merely inserting the knife flat beneath it, and turning its edge towards the tendon, while the assistant manipulates the foot suitably to the convenience of the operator. The tendon is displaced inwards by the adduction of the foot, and the artery and nerve are quite out of danger.

No special directions are required for dividing the contracted fascia and muscles in the sole.

Numerous apparatus for the treatment of varus are in use, but space forbids me to dwell with any minuteness on the subject. I append a representation of one which seems to me as useful and as little cumbrous as any, and which will illustrate the general principles on which they are constructed. The heel being carefully kept in the hole made for it in the back of the footpiece, the foot is to be secured in the latter, the sole of the footpiece being applied to the foot, not the foot forced on to the sole. It is kept in position by straps over the ankle and toes, as seen in the figure. Then the leg and thigh are secured, and the instrument is in position. The joint at the knee is made free, so that the leg-and-footpiece may be the less liable to displacement. One of the screws changes the angle of inclination of the sole to the horizon, and the other regulates the inclination of the axis of the foot to that of the leg, the former correcting the tendency to varus, the latter that to equinus. The great point in the successful management of cases of clubfoot is, after the complete division of the affected tendons, to manage the instruments with so much gentleness that the skin may never become excoriated or ulcerated by the pressure of the straps, and that the foot may always be well applied to the solepiece. The inclination of the various parts of the apparatus should, therefore, be varied very gradually, almost imperceptibly, and the apparatus should be frequently removed, well padded in every part where pressure may be apprehended, and the position of the straps slightly altered if any redness appears.



FIG. 239. Shoe for varus.—Holmes's 'Surg. Treat. of Children's Diseases.'

Very much, however, may be done without any formal instrument to remedy the abnormal position in clubfoot, sometimes without, but more generally after, the section of the tendons. Dr. Little, in an interesting pamphlet on this subject, printed for private circulation, has shown how

[1] 'Path. Trans.' vol. xxi. p. 417, and vol. xxiii. p. 308.

efficiently cases of slight severity may be dealt with by daily and intelligent manipulations, the foot being secured in the best available position on a simple splint of ductile metal in the intervals, and the position gradually approximated to the natural one. The same treatment should be assiduously carried out after tenotomy, and will often be found more efficient than that by expensive apparatus, which after all often fit very imperfectly.

Dr. Little gives two or three months as the average period required in the infant for the mechanical treatment of the highest grade of the deformity, in which the operation and the mechanical treatment have been divided into two or three stages. After this the child may be allowed at first to move about in the apparatus, and then a boot with side-irons should be substituted during the day, the varus-shoe being replaced at night, so long as any tendency to distortion is seen or apprehended.

Talipes valgus, in which the sole of the foot instead of being flat looks outwards, is a deformity usually noncongenital, dependent on spastic contraction of the peronei tendons, or partial paralysis of the tibiales. It is frequently complicated with T. equinus from weakness of the flexors, or with T. calcaneus from loss of power of the gastrocnemius. Talipes valgus and equino-valgus.

The grade of the deformity will indicate the treatment required. It is unadvisable to divide tendons unless absolutely necessary: but occasionally the peronei tendons, or perhaps only the peroneus brevis, must be divided, before apparatus can be applied to rectify the position of the sole; and when the tendo Achillis is contracted it is very frequently necessary to divide it.



Fig. 240. Talipes calcaneo-valgus congenitus. From a model in the Museum of St. George's Hospital. In this case the foot had six toes.—Holmes's 'Surg. Treat. of Children's Diseases.'

Pure T. calcaneus is still more rare, and it is still more rarely necessary to divide the flexor tendons. Talipes calcaneus.

The variety of valgus which is most commonly met with is the ordinary flatfoot, or spurious valgus. This deformity depends, in most cases, on a yielding of the calcaneoscaphoid ligament which supports the head of the astragalus and of the tendon of the tibialis posticus muscle which assists that ligament and forms so powerful a bond of union between all the bones of the tarsus. The long plantar ligament is also relaxed, as are doubtless all the ligamentous structures of the tarsus. The consequence is that in extreme cases the arch of the foot is obliterated, the astragalus descending till it touches the ground. In the worst cases the anterior part of the foot is even drawn upwards by the tibialis anticus and the extensors of the toes till the soles become convex antero-posteriorly instead of concave. The peronei, being no longer balanced by their chief antagonist muscle, draw the sole outwards. In extreme cases there is considerable pain in motion, which seems to depend on a stretched condition of the plantar nerves. This extreme grade is rarely met with, but a slighter degree of flatfoot is a very ordinary deformity in children, especially if they have previously been weakly, who are obliged to keep standing for too long at a time (as in factory labour)[1] or to carry heavy weights. In other cases it seems that the yielding of the arch of the foot depends on rachitic softening of the bones. Flatfoot.

The cure of this affection in its early stage is easy, whilst in aggravated cases only imperfect relief can be afforded. In the first place, the young person should be relieved from the labour, or the protracted standing, which

[1] See a paper by Mr. C. Roberts, in 'St. George's Hospital Reports,' vol. vii.

paper I have carefully examined many cases under my own and other surgeons' care in which these tendons have been divided, and have failed to verify Mr. Barwell's statement. The foot, in favourable cases, is very nearly natural. Beyond some flattening of the arch and widening of the sole, there is little change in its external appearance, and the patient walks nimbly and with no perceptible limp. Nor is Mr. Barwell's method of extension, by means of indiarubber cords, hooked on to splints which are kept in place by plaster, at all easy to apply successfully in cases where the deformity is serious, since the traction necessary to correct the deformity will either pull the splints off or, if they are more securely fastened by the strapping, the latter will then cut into the skin. My own trials of this method have consequently been disappointing; yet its principle, that of substituting gradually increasing elastic tension for the muscles which are paralysed, is so obviously sound for the treatment of paralytic deformity, that I thought it right to direct the reader's attention to it. I consider it a valuable method of treatment in the slighter cases of paralytic deformity, though Mr. Barwell's statement of the evils attending tenotomy seems overdrawn, and tenotomy is still in general use in all ordinary cases.

Tenotomy is generally employed in the cure of clubfoot; sometimes, as in the case from which Fig. 233 was drawn, to facilitate the reduction of a fractured bone, sometimes of a dislocation; also for squint and wryneck, and in various deformities, as those produced by diseased hip, knee, &c. Muscles also are occasionally divided, either subcutaneously or otherwise, in plastic operations, as the levator palati mollis in staphyloraphy. In all these cases the object of the surgeon is to divide the tendon or muscle as cleanly and with as small a wound as possible; and, if the operation be subcutaneous, to keep the parts quiet until primary union is ensured. The attempt to put the parts at once into the desired position after subcutaneous tenotomy may, indeed, be successful, but it is somewhat risky, for suppuration may easily follow, and then time will be lost instead of gained; or the divided tendon may be matted to the parts around, and the attempt to cure the deformity prove an entire failure; whilst the slight delay in waiting for primary union does not increase the difficulty of treating the case at all, since the uniting medium is perfectly soft and extensible then and for a long time afterwards.

I now turn to the various kinds of clubfoot.

Talipes equinus.

Talipes equinus is the deformity produced by a contracted state of the gastrocnemius muscle drawing the os calcis directly upwards, and causing the patient to walk on the metatarso-phalangeal joints and the toes, the foot bearing a strong resemblance to that of a horse, whence the name. Figs. 235, 236, taken from an old neglected case of this deformity, will give a better idea of its anatomy than words can do. It will be seen that the heel-bone is drawn into a tolerably vertical position, the tarsus is much curved forwards, so that the metatarsus approaches the os calcis; and the muscles of the sole of the foot, with the plantar fascia, are very much contracted, the long muscles in front proportionally stretched, those on the inner and outer aspects of the foot not materially affected.

The cure of the deformity is to be sought in the elongation of the contracted gastrocnemius muscle. In very slight incipient cases this might perhaps be done by repeated manipulations and by the gradual traction of a splint of ductile metal applied in front, the angle being carefully changed till the foot is drawn up to and beyond a right angle.

Tenotomy offers a ready means of restoring the position of the foot, and experience proves that the muscle after its elongation may recover its functions sufficiently for all the purposes of ordinary life. So that if the deformity is at all strongly pronounced—that is, if the foot cannot be brought to a right angle, or on being released flies strongly back—it seems of little use to waste time on less effectual treatment. The tendo Achillis should be divided by turning the child on its belly and introducing the tenotome on the inner side below and as close to the tendon as possible, a short distance above the point of its attachment, where it seems thinnest, the foot being still extended. When the knife is fairly under the tendon the foot is to be strongly flexed by the assistant, while the surgeon, with a slight sawing motion, presses the knife's edge against the tightened tendon. As soon as it has been sufficiently divided the extending force will rupture it with an audible snap, when the knife should

Division of the tendo Achillis.

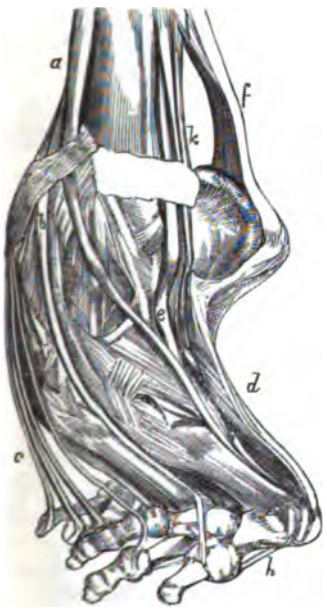


FIG. 235. A preparation of talipes equinus seen from the inner side. *a*, tibialis anticus; *b*, extensor proprius pollicis; *c*, extensor longus digitorum; *d*, skin, with contracted plantar fascia; *e*, tibialis posticus; *f*, tendo Achillis; *k*, tendon of flexor longus pollicis; *h*, flexor longus digitorum.

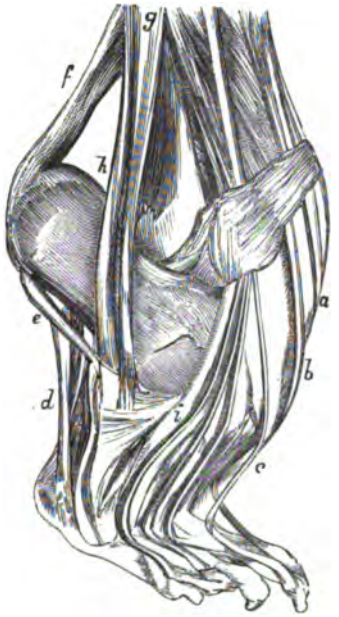


FIG. 236. The same preparation seen from the outer side. *a*, tibialis anticus; *b*, extensor proprius pollicis; *c*, extensor longus digitorum; *d*, flexor brevis digitorum; *e*, plantar fascia; *f*, tendo Achillis; *g*, *h*, peroneus brevis and longus; *i*, peroneus tertius.—From a preparation in St. George's Hospital Museum, Ser. iv. No. 22.

be instantly turned flat, so that the skin may not be cut, and should be withdrawn. If the operation has been dexterously performed hardly a drop of blood will escape. The wound should be strapped, and the foot placed on a splint in the extended position in which it was found before the operation. No attempt should be made to bring it to the natural angle till the wound is soundly healed, which will probably be the case in about five days. In complicated cases the division of the plantar fascia, and possibly of some of the muscles of the sole, is necessary in order to unfold the tarsus, as will be sufficiently seen from Figs. 235, 236.

Scarpa's shoe is to be applied when the wound is healed, in order to stretch the uniting material and elongate the muscle to the extent necessary to bring the sole of the foot flat to the ground. When this is done (which in a

favourable case may be in about two months) a boot with irons is to be applied, to prevent re-contraction, and if the child is old enough he may be allowed to walk.

Talipes varus.

The severer forms of talipes equinus, such as that represented above, are commonly congenital; and, as Dr. Little has observed, such cases of congenital equinus usually remain throughout life purely equinus—i.e. the foot is perfectly straight, without any material deviation to the inside or the outside. But the common form of congenital clubfoot is talipes varus, or equino-varus. In the pure T. varus the os calcis would be on the same horizontal level as the metatarsus; but if this is ever the case it must be very rare. In practice the os calcis is always found more or less elevated—i.e. the case partakes more or less of the essential characters of T. equinus. The term T. varus is usually applied to those in which the heel is not very much elevated; when it is so the deformity is named T. equinovarus; but in ordinary nomenclature they may be regarded as synonymous.

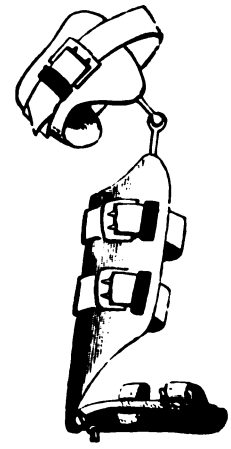


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The deformity consists in a simultaneous contraction of the tendo Achillis and the tendon of the tibialis posticus, that of the tibialis anticus being also almost always contracted, and very often the flexor longus digitorum as well. The internal portion of the plantar fascia is also constantly found contracted; and this, if the deformity is inveterate, involves also the contraction of one or more, or all, of the short muscles of the sole.

The deformity of course increases the longer it is neglected. When the child begins to walk he rests on the outer side and partly on the dorsum of the foot, on which part large bursæ usually form. If the skeleton of the foot be examined (Fig. 238) in a case of old deformity, the ankle-joint will be found distorted, the fibula being drawn behind the tibia, the internal malleolus almost or quite in contact with the scaphoid bone, the astragalus pushed out towards the outer side of the dorsum, the cuboid bone turned downwards, so that its dorsal face supports the arch of the tarsus; the metatarsus, which is curved towards the calcaneum, is more or less vertical instead of horizontal. In old cases all the bones are changed in shape, and the ligaments, muscles, and fasciæ have also undergone corresponding changes. Such cases are, of course, incur-



FIG. 238. Severe adult congenital varus, viewed from the front and inside; *a*, the tibia, cut down, in order to show the relatively posterior situation of the fibula; *b*, the external malleolus; *c*, the fibula; *d*, the posterior extremity of the os calcis drawn abnormally inwards; *e*, the astragalus unduly prominent on the dorsum of the foot; *f*, the navicular bone in contact with the internal malleolus; *g*, the cuboid, its posterior surface applied to the ground.—From Little, in 'Syst. of Surg.' vol. ii. p. 231; 3rd ed.

able; or, if the position of the foot is to be remedied at all, it can only be so by excising some of the deformed bones. But in early life, while the structures are yielding, and the parts have not undergone any irremediable change, a very useful foot indeed may be obtained. In all the cases of cure which I have seen, a certain degree of flattening of the sole remained, and the patient, if severely tested, would not have been able to run, hop, or leap from a height with the same force or security as one who had the natural arch and spring of the foot, but for ordinary locomotion there is often little to be desired.

The treatment by manual extension or by india-rubber bands or other mechanism may succeed in the slighter cases, but for cases of ordinary severity the section of the tendo Achillis and that of the two tibial tendons is commonly necessary. Very often also the plantar fascia and the muscles in the sole of the foot will require division.[1] Many surgeons prefer to divide the tibial tendons first, and to convert the deformity into one of simple equinus before dividing the tendo Achillis, and this is no doubt the better plan in the graver cases of the deformity, since the heel forms a firmer *point d'appui* for the instrument than if the great tendon has been divided. The operation of dividing the tendon of the tibialis posticus in a fat baby is not always an easy one, and several cases have occurred in which the child, having accidentally died soon after the supposed tenotomy, it has been proved by dissection that the tendon had been missed. The small size of the tendon and the depth at which it lies buried account for these mistakes. Another danger is that of wounding the posterior tibial artery, which lies close to the tendon in the leg. For this reason apparently some surgeons have practised the division of the tendon in the tarsus, but in the infant it is very difficult indeed to find it there. The sharp tenotomy-knife is to be introduced close to the posterior edge of the tibia,[2] about an inch above the ankle; and the fascia having been freely opened (including the sheath of the muscles), a blunt-pointed tenotome is substituted for it, and its edge turned towards the tendon. An assistant holds the foot inverted during this stage of the operation. Then he forcibly everts the foot, and as the operator raises his knife the tendon is felt to yield. If the operator believes that he has missed the tendon he must re-introduce his knife close to the bone, pass it somewhat more deeply, and repeat the previous manœuvres. It is very difficult in relapsed cases, where the tendon has been previously divided, to be sure whether it has been severed or no. The assistant often feels the snap of the divided tendon more plainly than the surgeon. If profuse bleeding and blanching of the foot testify to a wound of the posterior tibial artery, careful graduated pressure should be made on the wound, and the limb be neatly and firmly bandaged (but not too tight) from the toes upwards on a splint; and no extension should be made for at least a fortnight. The accident is believed to happen very often, but in only one case was it ever thought necessary to tie the artery afterwards, and then, it is believed, only in consequence of extension having been used too soon. The flexor longus digitorum is often divided at the same time as the tibialis posticus, either accidentally or purposely. Much has been said about the risk of loss of motion afterwards in consequence of the adhesion of the divided ends of the

Division of the tibial tendons.

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Very much, however, may be done without any formal instrument to remedy the abnormal position in clubfoot, sometimes without, but more generally after, the section of the tendons. Dr. Little, in an interesting pamphlet on this subject, printed for private circulation, has shown how

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Dr. Little gives two or three months as the average period required in the infant for the mechanical treatment of the highest grade of the deformity, in which the operation and the mechanical treatment have been divided into two or three stages. After this the child may be allowed at first to move about in the apparatus, and then a boot with side-irons should be substituted during the day, the varus-shoe being replaced at night, so long as any tendency to distortion is seen or apprehended.

Talipes valgus and equino-valgus.

Talipes valgus, in which the sole of the foot instead of being flat looks outwards, is a deformity usually noncongenital, dependent on spastic contraction of the peronei tendons, or partial paralysis of the tibiales. It is frequently complicated with T. equinus from weakness of the flexors, or with T. calcaneus from loss of power of the gastrocnemius.

The grade of the deformity will indicate the treatment required. It is unadvisable to divide tendons unless absolutely necessary: but occasionally the peronei tendons, or perhaps only the peroneus brevis, must be divided, before apparatus can be applied to rectify the position of the sole; and when the tendo Achillis is contracted it is very frequently necessary to divide it.



Fig. 240. Talipes calcaneo-valgus congenitus. From a model in the Museum of St. George's Hospital. In this case the foot had six toes.—Holmes's 'Surg. Treat. of Children's Diseases.'

Talipes calcaneus.

Pure T. calcaneus is still more rare, and it is still more rarely necessary to divide the flexor tendons.

Flatfoot.

The variety of valgus which is most commonly met with is the ordinary flatfoot, or spurious valgus. This deformity depends, in most cases, on a yielding of the calcaneoscaphoid ligament which supports the head of the astragalus and of the tendon of the tibialis posticus muscle which assists that ligament and forms so powerful a bond of union between all the bones of the tarsus. The long plantar ligament is also relaxed, as are doubtless all the ligamentous structures of the tarsus. The consequence is that in extreme cases the arch of the foot is obliterated, the astragalus descending till it touches the ground. In the worst cases the anterior part of the foot is even drawn upwards by the tibialis anticus and the extensors of the toes till the soles become convex antero-posteriorly instead of concave. The peronei, being no longer balanced by their chief antagonist muscle, draw the sole outwards. In extreme cases there is considerable pain in motion, which seems to depend on a stretched condition of the plantar nerves. This extreme grade is rarely met with, but a slighter degree of flatfoot is a very ordinary deformity in children, especially if they have previously been weakly, who are obliged to keep standing for too long at a time (as in factory labour)[1] or to carry heavy weights. In other cases it seems that the yielding of the arch of the foot depends on rachitic softening of the bones.

The cure of this affection in its early stage is easy, whilst in aggravated cases only imperfect relief can be afforded. In the first place, the young person should be relieved from the labour, or the protracted standing, which

[1] See a paper by Mr. C. Roberts, in 'St. George's Hospital Reports,' vol. vii.

has caused the deformity; the arch of the foot should be supported and pressed upwards by a spring or a pad fixed on the inner side of the sole of the boot or shoe; any tendency to eversion of the foot should be opposed by side-supports; the weakened muscles should be galvanised; the patient should be allowed long periods of rest in the recumbent position, but the structures should at the same time be strengthened by such an amount of brisk exercise as can be taken without fatigue, and the general health should be carefully attended to.

Mr. Ellis of Gloucester has lately published an interesting pamphlet 'On the Arch of the Foot,' in which he shows how much the natural shape of the foot depends on muscular action and muscular tone—chiefly on the integrity and power of the tibialis posticus, but also in a great measure, as Mr. Ellis thinks, on the flexor longus pollicis. Hence Mr. Ellis insists, and as it appears to me with incontestible accuracy, on the necessity for active exercise of the muscles in the treatment of flatfoot. Persevering use of the tibialis and of

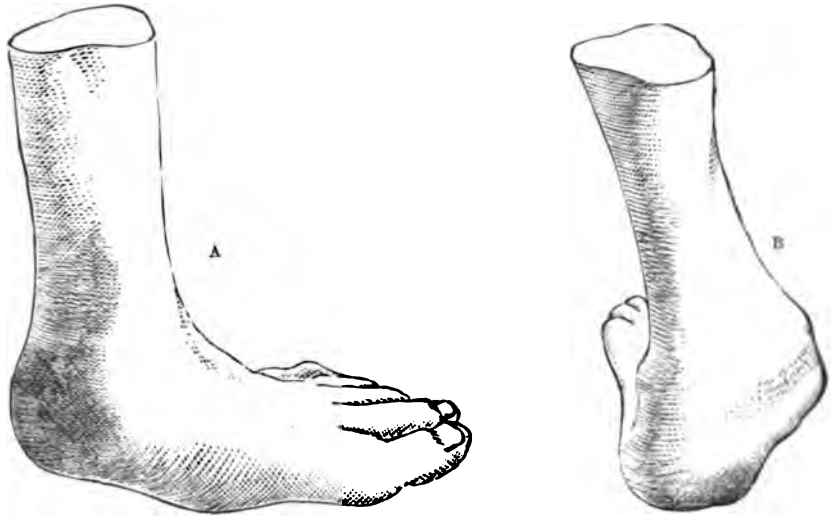


FIG. 241. A. Drawing, from a model in the Museum of St. George's Hospital, of ordinary flatfoot, or non-congenital talipes valgus.—Holmes's 'Surg. Treat. of Children's Diseases.' B. The same model drawn from behind.

the flexor muscles (the 'bowstrings,' as Mr. Ellis calls them, of the plantar arch) by standing and walking on tiptoe, hopping and other similar exercises and games, alternated with proper periods of complete rest, will do more than any apparatus to counteract the tendency to flatfoot, and to restore the arch as far as is possible when it has been flattened out.[1]

It is said that in severe cases section of the peronei tendons is justifiable; but I have never met with such a case.

Talipes cavus.

A rare form of talipes is described under the name of T. cavus, in which, without any contraction of the long tendons, the plantar fascia and short muscles of the sole are contracted so as to bring the metatarsus nearer to the heel. This has already been discussed as a common accompaniment of the ordinary congenital clubfoot, and it is also a striking feature in many cases of congenital talipes calcaneus. As a substantive deformity I am not acquainted

[1] On the subject of the pathology and treatment of flatfoot I would refer the reader to an excellent article by Mr. Marsh in 'St. Bartholomew's Hospital Reports,' vol. xviii. pp. 32 et seq.

with it, and it would in any such case be a serious question whether its treatment would not involve as much loss of power as the deformity itself.

Relapsed clubfoot.

Cases of relapsed clubfoot are often very difficult to treat; the tendons which had been divided having perhaps acquired adhesions to the neighbouring parts, or being so matted to the cellular tissue around that it is by no means easy in the renewed operation to satisfy oneself as to their being satisfactorily divided. This applies especially to the tibialis posticus. The fact furnishes an additional motive for care in the original treatment of the case. But in many cases of relapse, provided the cure has at the time been complete, no further operation is necessary, for the foot can be brought straight again by manipulation and instrumental treatment.

Resection of tarsal bones in talipes.

In cases of very obstinate clubfoot, where treatment has been unsuccessful or has been neglected, it may be justifiable to remove a portion of the tarsus. Either the cuboid bone may be excised, as has been done with success by Mr. Solly[1] and Mr. Davy, or the astragalus, as practised by Mr. Lund, or more extensive resection of the external tarsal bones may be practised, whether by sawing out a wedge-shaped piece or by dissecting the bones out of their articulations until the foot can be straightened. It must then be kept in its natural position on a splint till the wound has healed.[2]

Irregular deformities.

It would hardly be possible to enumerate and describe the various irregular deformities which follow upon spastic contraction of muscles in infancy, the result of injury or disease of the nervous centres, or upon infantile paralysis. The principles of treatment are the same in these distortions as in the ordinary clubfoot, viz. to endeavour if possible to correct the position of the limb by properly-contrived apparatus; and if this is not possible, to divide any muscular, tendinous, or ligamentous structure which offers definite resistance, and then apply the apparatus, and continue the treatment till the limbs are straight and have recovered as much motion as the condition of the muscles will allow.

Clubhand.

One of the most grievous of the irregular deformities is 'clubhand,' in which the tendons of the wrist and fingers are contracted, and the hand variously distorted, generally in the sense of flexion. The treatment is not very successful; and, as Dr. Little has pointed out, tenotomy is by no means promising in such cases. As much good seems to be done by the persevering use of manipulation, friction, and galvanism, aided by mechanical supports and by active movement as far as possible, as can be expected from tenotomy. In fact, in the few cases in which I have myself seen the operation practised it has seemed useless, unless, perhaps, as an adjunct to mechanical treatment.

Contracted palmar fascia.

The hand is liable to a very inconvenient deformity from the contraction of the palmar fascia and of subjacent tendons, which is in many respects analogous to rheumatism, and is usually regarded as a rheumatic symptom, though it has not the pain which is characteristic of rheumatism; and the patients often refer it to injury or to the constant irritation of some form of manual labour. The fingers affected are generally the ring and little fingers, sometimes the middle finger only. The deformity may generally be remedied by a free division of the fascia and tendon in one or more places, in which the

[1] 'Med.-Chir. Trans.' vol. xl. p. 119.

[2] See Davies-Colley, 'Med.-Chir. Trans.' vol. lx. p. 11; Lund and West, 'Brit. Med. Journ.' Nov. 2, 1878. Davy, 'Brit. Med. Journ.' May 12, 1883.

skin should be spared as far as is possible, and the application of an appropriate extending apparatus; but much patience and a prolonged use of passive motion will be required. This affection was first described by Dupuytren ('Leçons Orales'), and is often styled 'Dupuytren's contraction.' Dissection led him to conclude that the palmar fascia was alone affected, and this is also Mr. Adams's opinion,[1] but there seem to be cases in which the flexor tendons, or their sheaths, are also involved.

Knock-knee.

Knock-knee is a most troublesome affection as it is usually seen in out-patient hospital practice; for the ignorant parents of such children have generally gone on the assumption, which is so easily adopted by people who are both poor and busy, that 'the child will grow out of it,' and have neglected it till it is hardly in a curable condition. No doubt children do grow out of knock-knee to a certain extent, if the disease is only moderately severe, i.e. the limbs as they strengthen become straighter, and the gait so firm that the remaining obliquity is not noticed through the clothes. But some obliquity will be found on examination, and even this partial recovery is only obtained in the milder cases. When the knees have become very oblique further standing and walking tends rather to stretch the over-strained ligaments further and increase the deformity than to diminish it by strengthening the muscles.

Pure knock-knee, as it may be termed, consists in mere relaxation of the ligaments and muscles, whereby the natural pressure of the lower end of the femur inwards, acting on the weakened internal lateral ligament, stretches it.[2] This throws the tibia inwards and turns its external tuberosity somewhat upwards, whereby it is made to press on the external condyle of the femur. To this succeeds a relatively increased growth (or prominence downwards) of the internal condyle. Whether this relative increase is real—i.e. the internal condyle is hypertrophied, or apparent, i.e. the external is atrophied—it is not very easy to say;[3] but the difference in the level of the two condyles is very easily verified in these cases of pure knock-knee. Again, there is a class of cases in which the knock-knee is combined with, and in the opinion of many surgeons of experience is caused by, flatfoot; while others reverse the connexion and believe the flatfoot to be caused by the knock-knee. Knock-knee is also frequently caused by rickets, the shaft of the femur being bent so that its internal part is made to press unnaturally on the ligaments of the joint. It is also the opinion of Messrs. Jules Guérin and Brodhurst that the deformity is often due to contraction of the biceps tendon and the ilio-tibial band of the fascia lata.

The ordinary knock-knee requires that the displaced bones should be drawn outwards by means of a strap or elastic spring, which is fixed to a rigid upright on the outside of the leg, this upright being supported by a pelvic girdle and being let into the sole of a strong boot. By this apparatus the knee is kept fixed, and this is essential for a time. But when the obliquity has been corrected to some extent, a joint is introduced into the upright, and the child is permitted and encouraged to use the flexor and extensor muscles of the leg.

[1] 'Brit. Med. Journ.' June 29, 1878. A very interesting series of papers on this subject by Dr. Myrtle, Mr. Reeves, and Mr. Adams will be found in the 'Brit. Med. Journ.' Dec. 3 and 31, 1881, and Jan. 21, 1882.

[2] This is often termed 'statical' knock-knee. There is often some trace of old rickets, but not to any such degree as to occasion the deformity of the knee.

[3] It has been proved in some cases, by dissection, that the difference in level of the condyles has depended on an obliquity of the whole epiphysis and not on any difference in the size of the condyles.

In most forms of knock-knee, the deformity is only perceptible in the extended position. In complete flexion the muscles draw the tibia straight and the inward inclination disappears.

In neglected cases, when the deformity is so considerable as to form a real impediment to walking, an operation should no doubt be performed. It must however be clearly understood that such operations ought never to be necessary. If the parents do their duty in bringing the deformity when incipient under medical care, and if proper splints are used, it will never increase to the extent of requiring surgical operation.

In the first class of cases, which I have called pure knock-knee, those in which no serious deformity is perceived in the bones, except the relative increase in the length of the internal condyle, the appropriate operation is that in which the projecting part of the condyle is severed from the shaft of the bone, either with a saw or chisel, and then is pushed upwards by bringing the tibia into a straight line with the femur. A small vertical incision is made down to the femur near the insertion of the adductor magnus. Then if a saw is to be used (on Dr. Ogston's plan), a track having been made for it with the knife, by thrusting the blade down in front of the bone into the joint towards the inner side of the crucial ligaments, the condyle is severed by passing the saw through it from before backwards, till the piece is movable. If a chisel is used (Mr. Reeves's plan) it is simply driven through the condyle downwards and outwards till the piece can be broken off. The latter plan has the merit that the knee-joint is less freely dealt with, and may possibly in some cases not be opened at all.

In cases of rickety curvature, division of the whole shaft of the femur somewhere near the epiphysis (Dr. MacEwen's operation) is more appropriate in most instances. He passes a scalpel down to the internal surface of the femur at the point of intersection of a line drawn transversely a finger's breadth above the top of the external condyle, and a longitudinal one drawn half an inch in front of the adductor magnus tendon, and makes an incision an inch or more in length. A chisel having been passed through this incision down to the bone, is then turned round so that its edge is perpendicular to the axis of the limb, and is made to penetrate the bone for about half or a third of its thickness. Then a finer chisel is applied, and if necessary a third, till the outer part of the bone will give way under slight force. If the tibia is also curved it may require division in a similar way. Mr. Barwell believes that this double division of bones is usually necessary. He first divides the external third of the femur above the epiphysial line, and then puts the limb partly straight by fracturing the rest of the bone. This leaves a triangular gap in the bone, and when this is believed to be filled up the tibia is divided transversely and the fibula obliquely about an inch below the joint.[1]

Finally, there are surgeons (Mr. Brodhurst, Mons. J. Guérin) who believe that by section of the tendon of the biceps, the ilio-tibial band of fascia, and the external lateral ligament, the most inveterate cases of knock-knee may be cured. I cannot accept this doctrine, though I believe that in some complicated cases these structures may require division as well as the bones.

All these operations must be performed with the minutest precautions against unhealthy suppuration which the surgeon's experience can suggest.

[1] All these methods will be found described and discussed by their authors in an interesting series of papers in the 'Brit. Med. Journ.' Oct. 18, 1879. I would also refer to a clinical lecture by Mr. Barker in the same journal, July 5, 1879, and to a very interesting paper by Mr. Marsh in 'St. Bartholomew's Hospital Reports,' vol. xviii. p. 27.

on. Then the neighbourhood of the nerve becomes very tender to the touch, and this is followed by pain, often agonising, extending along the ramifications of the nerve. In other cases all the branches of this or one of the other divisions of the fifth, or even all the branches of the trifacial nerve are similarly affected, producing in the latter case what is called hemicrania. It would be beside my purpose to speculate on the cause of this affection, or to spend any time in discussing its treatment. I merely wish here to direct the reader's attention to it as illustrating an affection of the nerves quite unconnected with inflammation—for the symptoms, intolerably severe at one minute, may have entirely disappeared at another—and also, for the same reason, not due to any abiding irritation in the course of the nerve. I may, however, add that the cure of this disorder must be sought in the discovery and removal of its cause, in the amendment of any disorder of the general health, and, in cases where no cause can be ascertained, in the administration of antiperiodic remedies, as quinine and arsenic, with free purgation, and the local application of aconite, or the subcutaneous injection of morphia, or morphia and atropine, before the paroxysm. It is curious, and is valuable as a diagnostic sign, that though the parts near the affected nerve may be excessively tender to the touch, yet firm pressure will generally relieve the pain, and patients with brow-ague often learn to give themselves some relief by pressing the finger firmly into the supraorbital notch.

Many, however, of the cases classed as true neuralgia are really not periodic, but permanent affections, due to the implication of the nerve in inflammation of the bone in or near which it lies, or to its inflammation from some other cause, or to its being involved in cancerous or other ulceration, or compressed by a tumour. But in all these cases the symptoms are persistent and continuous, though not therefore necessarily equal in severity at all times. In other cases, from some irritation applied to the motor nerves, or to the part of the nervous centre with which they are connected, strange convulsive movements are produced. Spasmodic wryneck is the best known of these affections, and it manifests itself as an affection of the trapezius or sternomastoid and trapezius, which is often propagated to the other muscles of the neck and head, jerking the head about in various directions. From this origin the affection may be reflected to the nerves of the cervical or also of the brachial plexus, causing neuralgic pains in the course of their sensitive branches with possibly some affection also of the motor nerves.

Neurotomy and neurectomy.

In all cases of obstinate neuralgia, or of obstinate spasm, the question will ultimately occur whether any relief can be given by surgical operation, and if so, whether the symptoms are severe enough to warrant the attempt. I say this question occurs ultimately, for it is not until all known medical treatment has failed that the division of the affected nerve ought ever to be tried, except in cases where the pain obviously depends on some irritation applied to a definite part of the trunk, and such irritation cannot be otherwise removed. In such a case it may fairly be expected that the division of the trunk above this part will relieve the symptoms. When the cause of neuralgia is central or is unknown the operation is far less promising, though under proper circumstances it is quite right to give it a trial. There are two methods of dividing a nerve; one—which is the less formidable as an operation—is to make a subcutaneous puncture, or a small incision down to the bone in the known course of the nerve, by which the trunk is divided along with the parts in relation with it (neurotomy). But this is much less satisfactory than the other, both because the operator may after all miss the nerve, and because the latter

'les will at once show the extent of the contraction. Not uncom-
'e of the features on the affected side is strikingly less than on the
's are found in which the contraction affects only the clavicular
-cle, the sternal tendon being natural; or the reverse may be
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e division of the sternomastoid enables the surgeon to rectify the position of the head. No milder measure has succeeded in any case which I have seen, but it is said that slighter cases may be cured by manipulation and by instruments.

Division of the sterno-mastoid.

The operation is perfectly free from danger, if carefully performed, since the muscle stands out well from the vessels below it, which are again separated by a strong membrane; but a careless operator might possibly hit the internal jugular vein, especially in trying to divide the whole muscle from the same puncture. It is safer, however, to make a different puncture for each portion of the sternomastoid. The head should be put well on the stretch, so as to cause the muscle to stand out fairly, and the knife should be entered behind the clavicular fibres about half an inch above the clavicle and passed beneath the muscle. Then its edge is turned towards the fibres, and they are divided completely. Then the surgeon deals similarly with the sternal tendon. This plan is far better in my opinion than that of dividing the muscle from above, by passing the knife between the skin and the muscle and turning its edge downwards, which is recommended by some surgeons. After the operation the head can be considerably raised at once; but it is well to leave the patient alone for a few days, and then I think it better to apply an instrument consisting of a frame adapted to the pelvis and shoulders, with an upright along the spine, terminating above in a padded plate which rests on the back of the head, and carries two arms, which are fixed on one temple and on the opposite side of the chin, so as to have a firm hold of the head. The upright is jointed opposite the root of the neck, and is provided with three screws, one of which raises the chin and turns it to or even across the middle line; the second extends the cervical spine, drawing the chin away from the sternum; and the third brings the head and neck, considered as a whole, into the proper position as regards the trunk.[1] Other surgeons trust to manipulation, or to an arrangement of strapping and bandages, to restore the position of the head; but I confess that I think the use of an apparatus renders success much more certain and the treatment less troublesome. Manipulation, however, should not be neglected. It may be practised twice a day, when the instrument is removed for the purpose of washing. The patient is seated on the floor, between the knees of the surgeon or attendant, who gently draws the head into the desired position. And when the chin has been got into a position somewhat on the other side of the middle line from that in which it had been fixed, and has been kept there for about three weeks, the apparatus may be gradually disused and manipulation continued for a few weeks longer.

The ordinary spasmodic wryneck is not to be confounded with wryneck from disease of the cervical vertebræ. In such cases the characteristic symptoms of disease of the spine will be found on careful examination, and

[1] A figure of this apparatus, which I have found most efficient, will be found in the second edition of my work on the 'Surgical Treatment of Children's Diseases,' p. 666.

When so performed they do not seem to involve any excessive danger, and are undoubtedly justifiable in neglected cases of genu valgum. All surgeons of experience would agree with Dr. MacEwen[1] that no operation for genu valgum should be performed while the bones are still soft, for then they may no doubt be straightened either gradually or abruptly without any cutting operation. The limit may be taken as about eight years of age.

Dr. MacEwen's operations have been very numerous and very successful. 'Up to April 6, 1881, there were 767 limbs osteotomised, and in these 1,149 osteotomies were performed. Out of these there were three deaths from causes independent of the operation. Of the 767 limbs operated on, 521 were for genu valgum,' and he regards the operation as not more dangerous than a simple tenotomy. At the same time it is not to be denied that troublesome suppuration, ankylosis of the joint, and even pyæmia and death have followed on Ogston's and Reeves's operations, even in the hands of surgeons who attend minutely to antiseptic precautions, and we cannot admit that such extensive violence can be wholly free from danger, however carefully and skilfully the operation may be performed. I would repeat that proper care in the initial stages of the deformity ought to banish such operations from practice.

Rickety deformities.

The same principle which underlies Dr. MacEwen's operation for knock-knee has been also extensively applied by himself and other surgeons to rickety curves. There are two different ways of performing this operation. Some surgeons, as Adams, endeavour to make the section of the bone as nearly as possible subcutaneous; others, following the teaching of Mr. Lister, believe that this is not a matter of much importance, provided that the precautions are observed which, according to him, will infallibly keep the wound 'aseptic.' There are few surgeons, however, who would not think the operation safer with a small wound than a large one, and this is I think about the whole difference between the subcutaneous and the open method. As small a wound as possible should be made in the most advantageous position, and the bone chiselled until it will break, and then the limb is to be put up in the straight position. Very considerable deformity might require the removal of a wedge of bone, and then the operation differs in no respect from any other excision. The same observations apply to these as to operations for knock-knee. They should not be performed while the bones are soft, and proper attention during the course of the disease ought to render them altogether superfluous.

Wryneck.

Wryneck is a common deformity in children from spastic contraction of the sternomastoid muscle, by which the head is drawn down towards that shoulder, and the chin turned to the opposite side; the contracted muscle stands out strongly under the skin, especially when its action is opposed by manipulation, and measurement from the ear to the sternoclavicular joint on

[1] Trans. of International Med. Congress, 'Diseases of Children,' p. 190. I would refer the reader to this interesting debate for details which my space forbids me to notice. A description of the dissection of a knee-joint twenty months after Ogston's operation will be found in Langenbeck's 'Archiv,' vol. xxviii. p. 926. There was very little trace of the section on the articular cartilage, which was itself quite smooth and free from any trace of inflammation. At the upper edge of the section there was a slight projection, where the severed condyle had been pushed up; but the rest of the track of the saw was marked merely by a slight cicatrix, only visible when the bone had been sawn in half. The line of the epiphysial cartilage was broken in consequence of the displacement of the condyle about 1½ cmm. upwards, but this cartilage was otherwise healthy.

the two sides will at once show the extent of the contraction. Not uncommonly the size of the features on the affected side is strikingly less than on the opposite. Cases are found in which the contraction affects only the clavicular origin of the muscle, the sternal tendon being natural; or the reverse may be the case; but it is more common for both parts to be implicated. If the deformity be neglected the clavicle itself may yield and be curved upwards. The deformity is no doubt usually due to congenital causes, though it is often not noticed till some years after birth. The contraction involves other muscles of the neck also—the trapezius, scaleni, and others—but to a less extent; and the division of the sternomastoid enables the surgeon to rectify the position of the head. No milder measure has succeeded in any case which I have seen, but it is said that slighter cases may be cured by manipulation and by instruments.

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[1] A figure of this apparatus, which I have found most efficient, will be found in the second edition of my work on the 'Surgical Treatment of Children's Diseases,' p. 666.

no operation will be proposed. There are, again, cases in childhood in which wryneck appears to depend either on irritation from worms, or on some mental cause difficult to detect, but somewhat analogous to adult hysteria. In such cases the contraction is not permanent, but appears and disappears from time to time. In these cases, also, no operation should be performed. General treatment, with manipulation, or some contrivance to fix the head in a proper position, will suffice. The diagnosis may always be made by inducing anæsthesia, and then noting that there is no real permanent shortening of the muscle. Adults, again, suffer, though rarely, from a very obstinate and intractable form of spasmodic wryneck, somewhat allied to paralysis agitans, in which generally the other muscles of the neck are affected, and sometimes the trapezius as much as, or more than, the sterno-mastoid. The head is drawn down towards the shoulder. The affection is liable to remissions and exacerbations, evidently due to mental causes in part, and varying with the state of the mind. The disease may be due to irritation propagated from the medulla along the spinal accessory nerve; but the exciting cause of this irritation is unknown. In one case Mr. Campbell De Morgan obtained a cure by removing a part of the external branch of the spinal accessory nerve, and in other cases benefit has followed on the very free administration of the succus conii, as recommended by Dr. John Harley;[1] but the disease usually defies treatment.

Emotional and hysterical contractions.

Wryneck is often also purely hysterical, and these cases are of all others the most difficult to treat. They are also difficult of diagnosis; but the ordinary rules which are applicable to the diagnosis of other hysterical disorders, and the results of an examination under anæsthesia, will usually settle the diagnosis. But they will often be most rebellious to treatment; and this, indeed, is true also of all other forms of emotional or hysterical contraction. Operation seems to aggravate the disease. The section of the sternomastoid in wryneck has been promptly followed by contraction of the opposite muscle. Similarly, in hysterical diseases of joints, forcible extension of an elbow, the seat of hysterical contraction, has been the starting-point of nervous disorders which have been held to justify amputation, leaving the patient still uncured; and other similar instances might be quoted. As in other nervous disorders, the less active the surgeon is the better. It may sometimes be advisable to put the parts in a natural position under anæsthesia and fix them so, and thus give the patient an irrefragable proof that the deformity is not incurable. But the chief reliance must be placed in medical and general treatment, with manipulation and calisthenic exercises when they are indicated.

[1] 'Med.-Chir. Trans.' vol. lvii.

CHAPTER XXVII.

AFFECTION OF NERVES.

Wounds of nerves occur, of course, from injuries of all kinds, but are peculiarly common in injuries from gunshot. They never occur uncomplicated, but in some cases the wound in the nerve is the chief feature of the injury. The symptoms of wound of a nerve vary according as the nerve is sensory, muscular, or mixed, and as the wound is partial or complete. Complete division of a large mixed nerve (of which the most familiar example is the ulnar or median, at the wrist) produces total loss of the function of the muscles supplied from below the point of division, and loss of sensation in the part corresponding to its distribution, together with a sensible loss of temperature in the limb below, and loss of nutrition, sometimes leading to low eruptions on the skin.[1] Division of a purely muscular nerve such as the portio dura, is usually accompanied only by muscular paralysis; at least, as far as is known, for thermometric observations in such cases are difficult and uncertain. Division of sympathetic trunks is known to be accompanied by dilatation of the capillaries and increased heat of the parts, from experiments on animals; but in man such lesions could only form subordinate features in complicated injuries.[2] The anatomical phenomena of wounds of nerves and of their repair is thus described by Dr. Lockhart Clarke.[3] 'Both portions of the divided nerve retract a little, and their extremities, especially the upper one, enlarge and become more vascular, while coagulable lymph exudes around and between them. In a short time this exudation becomes gradually firmer, and is found to contain cells and nuclei, and then fine nerve-fibres, which proceed from the extremity of the central portion of the nerve to that of the peripheral portion, which, on being separated from its nervous centre, undergoes a gradual but rapid atrophy or degeneration. These newly-formed fibres are finer and greyer than those of the central portion of the divided nerve, and it is not till after a period of some months that they become fully developed. In the meantime a regeneration of fine fibres is going on in the peripheral or atrophied portion of the nerve; but it is a long time before these fibres acquire the normal size and appearance. The same kind of reparative process takes place when a portion of a nerve has been excised, only it requires a longer period.'[4] The remote consequences of wounds of nerves are very various. I have seen a case in which the total division of the musculospiral nerve—evidenced by complete loss of sensation in the parts supplied by the radial and by loss of power in all the extensor

Wounds of nerves.

[1] See a paper by Mr. Jonathan Hutchinson, 'On Injuries of Nerve-trunks.'—'London Hosp. Reports,' vol. iii. p. 321.

[2] Dr. Chevasse of Birmingham, in the 'Brit. Med. Journ.' Dec. 17, 1881, relates a case of injury to the cervical portion of the sympathetic in a surgical operation.

[3] On this point the reader may also usefully consult Dr. Weir Mitchell's treatise on 'Injuries of Nerves and their Consequences,' 1872, pp. 74–81. This interesting work should be studied in connexion with the whole subject of this chapter, as well as the translation of Charcot's 'Lectures on Diseases of the Nervous System,' recently published by the New Sydenham Society.

[4] 'Syst. of Surg.' 3rd ed. vol. ii. p. 186.

muscles of the limb—was followed after the lapse of some months by gradual, but ultimately complete, recovery of all the functions of the nerve.[1] Mr. Syme has put on record a case in which the ulnar nerve was divided in an excision of the elbow, and in which the functions of the nerve were also regained; and here, on dissecting the parts some years afterwards, the ends of the divided nerve were found united by a kind of splint or ferule of fibrous tissue (exactly as a fracture is united by provisional callus), inside which the ends themselves seemed to be ununited, though in contact. But in other cases there seems no doubt that a permanent irritation is generated in the substance of the wounded nerve which is reflected down other nerves, originating from the same part of the cerebrospinal centre, and that thus the whole limb may ultimately become more or less paralysed.[2] There are numerous other reflex symptoms produced by injuries to the nerves, but they are too miscellaneous and too rare to make it worth while to summarise them here, and in most of the recorded cases the real symptoms have doubtless been mixed with many which were of a hysterical character. I would refer the reader to an interesting article by Dr. Brown-Séquard in the 3rd edition of the 'System of Surgery.' Partial division of nerves. or their permanent irritation by the lodgment of a foreign body, or a ligature, is liable to produce symptoms even more formidable than those caused by their complete division, though essentially of the same character. The abiding irritation which sometimes ensues on the implication of a divided nerve in a cicatrix is of the same nature. A common example of it is the irritation and jerking which occasionally attacks the stump of an amputation. Sometimes the nerve is compressed by the formation of callus around a fracture, and not unfrequently the nerves in the axilla are so pressed upon by the constant use of a crutch that a well-known form of palsy, 'crutch-palsy,' is produced.

The symptoms caused by injury to a nerve must be treated according to their gravity. Since there can be no doubt that many of the worst symptoms depend on some constant irritation, the result of partial division, the lodgment of a foreign substance, or the implication of one or more nerves in the cicatrix, it is right in such cases to cut down on the nerves which seem implicated, and either divide them completely or remove a portion of them. In cases depending on lesion of one of the digital nerves it may often be better to sacrifice the finger, and in painful stumps to re-amputate, taking care to cut all the large nerve-trunks so short that they cannot be implicated in the scar.

But in slighter cases the symptoms will probably subside by galvanism of the affected nerve, sedulously employed, blisters, the application of belladonna in ointment, and the hypodermic injection of morphia, if there is much pain, with careful attention to the general health.

Suture of nerves.

In all recent wounds, in which large nerves are divided, great care should be taken to put their extremities into accurate apposition, and to pass a silk or gut suture through the soft parts around or the sheath of the nerve, so as to keep them in accurate contact. In his address on Surgery, published in the 'Brit. Med. Journ.' Aug. 5, 1876, Mr. Favell refers to four cases of wounds of nerves, in which the divided nerve was united by suture. In the first (under Mr. Wheelhouse's care) the great sciatic nerve had been cut entirely across, and its ends were united by carbolised catgut suture nine months after the

[1] This case is mentioned in a paper by me in the 'Lancet,' June 16, 1883.

[2] See a case related by Mr. Callender, in 'Path. Trans.' vol. xv. p. 180, in which the ulnar nerve seems to have been divided in excision of the elbow, and where the whole limb became paralysed.

accident. In the second the median nerve was united by suture ten weeks after its division; but the result was unsatisfactory. In the two others, where the sutures were applied immediately (to the median and ulnar nerves), perfect recovery ensued. In Mr. Wheelhouse's case the man had been admitted into hospital only in order that his limb should be amputated, as it was totally palsied and useless. On cutting down on the divided nerve its proximal end was found swollen, and the distal atrophied. Both were removed, leaving a gap of two inches in the nerve. By bending the limb, the ends were brought near enough to admit of their being sewn together with catgut. Gradually the various functions of the nerve were regained, and the patient was able to use his leg. He regained the perfect use of it, and had been at work about a year as an agricultural labourer when last heard of—but lost two toes by gangrene in the cold weather.

Much more extensive experience has now been obtained of this operation of nerve suture, which justifies me, I think, in saying that in all cases where the function of a limb is lost from the division of a large nerve it is not only justifiable, but imperative, to cut down on the nerve, refresh its ends and unite them. The prospect of success is of course less the longer after the accident the operation is performed; but cases are on record in which the operation has succeeded even some years after the injury. I think, however, it is better, if the nerve has not been united at once (primary suture), to wait until the wound has perfectly healed (secondary suture), and not to operate while the divided nerve and the parts around are in an inflamed condition. It should be added that the improvement in the symptoms is often long delayed. I have recorded cases in which no change was perceptible for several months after the operation, but where, ultimately, entire recovery ensued.[1]

Besides the direct and remote consequences of wounds, there are a few other affections of nerves which are occasionally met with, though as a rule the symptoms which are caused by lesions of nerves are only somewhat subordinate features of surgical diseases and injuries.

Neuralgia.

Neuralgia, in its strict sense—i.e. pain referred to the course and distribution of some one or more of the sensory nerves—is a disease which is almost always periodic in its attacks, and bears a strong resemblance to ague in its course, causation, and cure, and falls more especially under the care of the physician. Still surgeons are so often consulted about it, and an accurate diagnosis of many surgical affections depends so much on a knowledge of the phenomena of true neuralgia, that I must say a few words about it. The word neuralgia is used loosely to describe any painful affection for which no anatomical or organic cause is known, and there would be no objection to this use of the word if some other term were used to distinguish the cases which are of hysterical, dyspeptic, mental, or obscure origin from the truly neuralgic—intending by the latter term those in which there is distinct evidence of an affection limited to a precise nerve, and dependent, we cannot doubt, on some anatomical disturbance of its tissue, though this may be transient and imperceptible to our senses.

The phenomena of true neuralgia are best studied in the familiar affection known as tic, or brow-ague, which follows the course of the supraorbital branch of the fifth nerve. This commences very commonly by an increased afflux of blood, the pulsation in the little artery which accompanies the nerve becoming plainly perceptible to the sight and touch as the pain is coming

[1] See a paper by myself in the 'Lancet,' June 16, 1883, and by Mr. Page, 'Brit. Med. Journ.' June 23, 1883.

on. Then the neighbourhood of the nerve becomes very tender to the touch, and this is followed by pain, often agonising, extending along the ramifications of the nerve. In other cases all the branches of this or one of the other divisions of the fifth, or even all the branches of the trifacial nerve are similarly affected, producing in the latter case what is called hemicrania. It would be beside my purpose to speculate on the cause of this affection, or to spend any time in discussing its treatment. I merely wish here to direct the reader's attention to it as illustrating an affection of the nerves quite unconnected with inflammation—for the symptoms, intolerably severe at one minute, may have entirely disappeared at another—and also, for the same reason, not due to any abiding irritation in the course of the nerve. I may, however, add that the cure of this disorder must be sought in the discovery and removal of its cause, in the amendment of any disorder of the general health, and, in cases where no cause can be ascertained, in the administration of antiperiodic remedies, as quinine and arsenic, with free purgation, and the local application of aconite, or the subcutaneous injection of morphia, or morphia and atropine, before the paroxysm. It is curious, and is valuable as a diagnostic sign, that though the parts near the affected nerve may be excessively tender to the touch, yet firm pressure will generally relieve the pain, and patients with brow-ague often learn to give themselves some relief by pressing the finger firmly into the supraorbital notch.

Many, however, of the cases classed as true neuralgia are really not periodic, but permanent affections, due to the implication of the nerve in inflammation of the bone in or near which it lies, or to its inflammation from some other cause, or to its being involved in cancerous or other ulceration, or compressed by a tumour. But in all these cases the symptoms are persistent and continuous, though not therefore necessarily equal in severity at all times. In other cases, from some irritation applied to the motor nerves, or to the part of the nervous centre with which they are connected, strange convulsive movements are produced. Spasmodic wryneck is the best known of these affections, and it manifests itself as an affection of the trapezius or sternomastoid and trapezius, which is often propagated to the other muscles of the neck and head, jerking the head about in various directions. From this origin the affection may be reflected to the nerves of the cervical or also of the brachial plexus, causing neuralgic pains in the course of their sensitive branches with possibly some affection also of the motor nerves.

Neurotomy and neurectomy.

In all cases of obstinate neuralgia, or of obstinate spasm, the question will ultimately occur whether any relief can be given by surgical operation, and if so, whether the symptoms are severe enough to warrant the attempt. I say this question occurs ultimately, for it is not until all known medical treatment has failed that the division of the affected nerve ought ever to be tried, except in cases where the pain obviously depends on some irritation applied to a definite part of the trunk, and such irritation cannot be otherwise removed. In such a case it may fairly be expected that the division of the trunk above this part will relieve the symptoms. When the cause of neuralgia is central or is unknown the operation is far less promising, though under proper circumstances it is quite right to give it a trial. There are two methods of dividing a nerve; one—which is the less formidable as an operation—is to make a subcutaneous puncture, or a small incision down to the bone in the known course of the nerve, by which the trunk is divided along with the parts in relation with it (neurotomy). But this is much less satisfactory than the other, both because the operator may after all miss the nerve, and because the latter

may soon reunite and the symptoms recur. The more effectual method is to expose the nerve by a regular dissection, and remove a piece about half an inch long (neurectomy).[1] Dr. A. Brown [2] has recorded a case in which he destroyed a portion of the affected nerve with the actual cautery, and with a good result.



FIG. 242. Neuroma. A large oval tumour, 6 inches long by 4 wide, implicating the sciatic nerve and its posterior tibial branch. The tumour is hollow, presenting a large central cavity, with soft shreddy walls. The trunk of the nerve, *a*, is seen passing into the tumour above and emerging below at a point below the popliteal space. Various filaments are represented spread out on the walls of the tumour, *b b*, and many other nerves can be detected by examination in the central cavity. For about 1½ inches above the tumour the nerve is much thickened and indurated. All that is known of the history is that the limb was amputated. The chief mass of the tumour was found on microscopical examination to consist of fibrous tissue, of various consistence, granular amorphous material, round and oval cells of the size of pus-globules for the most part, elongating fibre-cells, and remnants of nerve-tubes. From a specimen, Ser. viii. No. 172, in St. George's Hospital Museum, described in vol. iv. of Beale's 'Archives.'

Neuroma.

Tumours are sometimes painful from their pressure on nerves, and in some of the 'painful subcutaneous tumours,' as they are called, a definite nerve has been found implicated in the tumour. At other times, however, there has been no such explanation of the pain, which is then to be regarded as 'hysterical.' Like other forms of hysteria, this pain in simple, fibrous, or fatty tumours generally occurs in women.

But there are tumours formed in the substance of nerves, and called on that account neuromata, of which a remarkable example is depicted here (Fig. 242). They are of a fibrous or fibrocellular structure, grow generally slowly, and are often the seat of very acute pain. The fibres of the nerve will be found spread out over them and embedded in their substance. They are incurable except by removal; and when such removal would involve the destruction of the main nerve of the limb and its consequent paralysis, amputation becomes necessary.[3]

Nerve-stretching.

Latterly the operation of exposing and stretching the trunk or trunks of the affected nerves has been practised in many cases where symptoms have

[1] Some interesting and typical cases of neurotomy in painful affections of the limbs will be found related by Mr. Redfern Davies, in the 'Dublin Quarterly Journal of Med. Science,' Nov. 1860. But the nerve which is most often divided or excised for neuralgia is the trigeminus. The division of the supra- or infra-orbital nerve in the face, either by direct dissection or by subcutaneous section is easy. On this subject the reader may consult a paper by Mr. Cadge, 'Brit. Med. Journ.' July 15, 1882. Lately, in America, the bold idea of removing Meckel's ganglion along with the infra-orbital nerve has been put in practice. The easiest method seems to be to turn up a large V-shaped piece from the cheek, trace the nerve along the infra-orbital canal through the antrum, and open the sphenomaxillary fossa by removing the back wall of the antrum. The reader who is curious on the subject will find the operation described in the second series of the 'Med. and Surg. Reports of the Boston (U.S.) City Hospital,' p. 262; but the results seem very uncertain, and it must remain doubtful whether a simple excision of a portion of the nerve would not have answered the same end.

[2] 'Brit. Med. Journ.' Nov. 6, 1880.

[3] As the subject is one which at present has little connection with practical surgery, I can hardly give it more space here. But the reader will be interested in studying the pathology and histology of those remarkable cases in which numerous tumours are developed in

been present referred to irritation of the nerves, which irritation it was hoped might subside after the disturbance and consequent change in the nutrition of the nerves which must be produced by their elongation. The original operation, which was most interesting and most successful, was performed by Nussbaum, and will be found related in the 'Deutsche Zeitschrift für Chir.' 1872, vol. i. p. 450. The patient was a soldier, who, after a wound in the nape of the neck followed by abscess, suffered from anæsthesia, contraction and violent cramps in the parts supplied by the brachial plexus, with almost permanent contraction of many of the large muscles, which however became quite flaccid during anæsthesia. The operation consisted in exposing the nerves surrounding the axillary artery and gently stretching each, and then exposing the brachial plexus in the subclavian triangle and following each nerve with the finger up to its point of exit from the spinal column, and stretching it by a considerable pull [einen mässigen Zug]. Sensation returned in the extremity immediately, all the cramps and other symptoms disappeared, and the man was discharged well. The original paper will well repay perusal. Mr. Callender was one of the first in this country who tried these operations, and his first case will be found recorded in 'Clin. Soc. Trans.' vol. vii. p. 100,[1] in which the median nerve was exposed and stretched in a case of neuralgia, with good results during the time the patient was under observation. The operation has also been performed in tetanus and other painful disorders of the nervous system, and in locomotor ataxy, and seems occasionally to have succeeded, but the method of its action and the indications for its performance are hitherto so far unexplained that I cannot enter further into the subject here.[2] I have assisted at a few of these operations, but have not hitherto seen much good from them. Still, in cases where the symptoms of nervous irritation are perfectly definite, where they are confined to a single set of nerves, or to nerves which have a common and accessible origin, and where they have resisted treatment for a sufficient period, the operation is justifiable. Verneuil recommends that the nerve should be squeezed, or crushed, as well as stretched.

I would refer the reader to Dr. Brown-Séquard's article for all that is known on this subject at present. It seems to result from the researches which are there summarised, that no harm is likely to result from the operation if even a greater force is employed than what is ordinarily judged advisable. Dr. Brown-Séquard thinks that the best method of stretching the nerve is to suspend a weight to it, and has shown that the sciatic nerve can bear a weight equal to that of the animal's body. He believes that the operation acts somewhat as a wound would do—i.e. by setting up an action in the distal part of the nerve followed by the same atrophy or degeneration which ensues on its division. He has also clearly proved that the effect of nerve-stretching is not limited to the nerve operated on; but is reflected to the nervous centre and through this to other nerves of near origin. In cases especially of obstinate neuralgia or spasm, where neurotomy is contemplated, it seems reasonable to make previous trial of stretching—and Dr. Brown-Séquard also recommends its use in lepra anæsthetica.

the course of nerves, apparently by an overgrowth of their fibrous sheath, in the excellent monograph of R. W. Smith, 'The Neuroma,' Dublin, 1849, and in a very interesting article by Dr. Prudden of New York on 'Multiple Neuroma' in the 'Amer. Journ. Med. Sci.' July 1880.

[1] See also 'Lancet,' June 26, 1875.

[2] I would refer to a paper by Dr. Cavafy in the 'Brit. Med. Journ.' Dec. 10 and 17, 1881, in which the results of nineteen cases are summarised and some valuable remarks on the method of operating are added.

CHAPTER XXVIII.

DISEASES OF THE ARTERIES.

Atheroma and calcification.

THE degenerative changes which are found in the arteries appear under two chief forms, viz. *atheroma*, a softening, pulpy change akin to fatty degeneration; and *calcification*, or so-called ossification, in which the arterial tube becomes rigid and brittle. The latter, however, is a late stage or consequence of the former. In atheroma the internal and middle coats of the artery are found thickened by a material which is variously regarded by different authors as the result of chronic inflammation affecting the middle coat and so pushing the internal coat inwards and afterwards invading it; or as the result of fatty degeneration. The former view of the inflammatory nature of atheroma is maintained with great ability by Dr. Moxon,[1] and is the one which certainly appears to me the more probable and the more consistent with the phenomena of the disease. The latter, however, rests on the great authority of Gulliver,[2] and is the view usually adopted. Mr. Moore[3] believed that atheroma originates in a deposit from the circulating blood on the lining membrane of the artery; but this view must, I think, be admitted to be erroneous.

However originating, the disease soon causes visible opaque patches, which are of a yellow colour, and thicker on section than the neighbouring portions of the internal coats. In these patches there are found on microscopic examination oil-globules, cholesterine, and the degenerated tissue of the internal coat of the vessel, besides cell-formations which are described by Rindfleisch, Moxon, and others as inflammatory.

The progress of atheroma is in one of three directions: 1. The atheromatous patch may soften into matter somewhat resembling pus, which passes into the tube of the artery, leaving a small cavity—the atheromatous ulcer—in the internal coat and inner part of the middle coat. The vessel at such a spot is much weakened, and may give way either totally and at once, or partially and gradually, so as to form an aneurism. This softening is regarded as the acutest form of the inflammation which has produced the disease. 2. The atheromatous matter may become organised into a low form of fibrous tissue, with which fatty matter is mingled, until the coats of the vessel become 'opaque, dull, and condensed into a material similar to hardened albumen, and eventually to ligament' (Moore). In this change also, I believe, aneurism often finds its commencement, the difference in elasticity at the points where the healthy and diseased parts of the vessel join predisposing it to give way at that part. 3. The salts of lime are deposited in the atheromatous matter by a still more chronic process; and then sometimes the whole vessel is gradually involved in this calcareous degeneration, so that it becomes a perfectly brittle and rigid tube, incapable of either contraction or dilatation or of any change in length. Such arteries may, of course, be ruptured by any slight force, and they are quite incapable of performing

[1] 'On the Nature of Atheroma in the Arteries,' from 'Guy's Hospital Reports.'
[2] 'Med.-Chir. Trans.' vol. xxvi.
[3] 'Syst. of Surg.' 2nd ed. vol. iii. p. 393.

one of the chief functions of arteries—that of regulating the blood-supply according to the demand. Hence the frequent occurrence of gangrene in such cases. The process of calcification is popularly denominated ossification of arteries; but there is no proof that true bone is found in such a patch, though a certain resemblance to bone-cells has been thought to be discovered in the calcareous deposit.

Sometimes in extensive calcification of the aorta the blood makes a way between the internal rigid and the external elastic portion of the artery, i.e. either between the external and middle coats or (as Dr. Peacock has shown to be almost always the case) between the layers of the middle coat, and distends the outer part of the artery into what is known as a 'dissecting aneurism' (Fig. 247, p. 529).

Both atheroma and calcification are frequent causes of secondary hæmorrhage after surgical operation, the latter more especially; in fact, the arteries are sometimes found to be so 'ossified' in amputations performed on aged people that they break off when an attempt is made to tie them. In such extreme cases of calcification the ligature must be used very gently, and only tied just tight enough to command the bleeding; or what is, I think, safer, acupressure may be employed. But secondary hæmorrhage is almost sure to ensue. Atheromatous arteries also are very liable to secondary hæmorrhage, being already badly nourished, and more prone to degeneration than to repair. I have shown from the records of St. George's Hospital that, judging from the result of fatal cases only, it would seem that secondary hæmorrhage is almost always due to disease of the arteries. ('St. George's Hospital Reports,' vol. i. p. 319.)

Calcification is a disease which is almost confined to advanced life, but it has been found in younger subjects also. Mr. Moore called attention to the fact that it is not found in the pulmonary artery or in any part of the venous system, in support of the view which he held that the disease commences on the internal surface of the vessel as a deposit out of the arterial blood.

Atheroma has been found to occur very commonly in soldiers, and in persons who are in the habit of indulging in alcohol; and it is believed by many pathologists to be a frequent result of syphilis, the deposit in this syphilitic variety of atheroma being of a fibroid texture. I cannot profess myself quite satisfied of the reality of the connection which had been thus assumed between two such common affections as syphilis and atheroma; but the connection between atheroma and spirit-drinking seems more certain. We should not forget, however, that arterial disease attacks persons also of the most regular habits of life, and is not unknown in the lower animals. The signs of this affection are wholly unknown. Persistent pains, reputed rheumatic, often turn out to be due to disease of arteries, and a high degree of arcus senilis in the cornea, especially if the patient is not in advanced age, gives reason for suspecting atheroma; but the suspicion is often refuted by dissection. Advanced calcification often renders the arteries so hard that their condition is plainly perceptible to the touch in any superficial vessels.

Occlusion and embolism.

Arteries may be occluded by the pressure of tumours, though the main arteries have a wonderful power of escaping and resisting pressure; but the usual cause of obliteration of an artery—at least of a large one—is *embolism*, i.e. the impaction of a clot. This generally occurs at or near the bifurcation, or giving off of some large branch (see Fig 11, p. 51). The clot is generally formed on a nucleus of fibrine which is brought down to the part from a

diseased endocardium, being washed off the surface of the heart or one of its valves, as long ago pointed out by the late Dr. Kirkes;[1] but clots formed in aneurisms or diseased arteries, or even in the veins, may prove the starting-point of embolism.[2] This plug of fibrine being detained in the artery attracts more fibrine to itself (just as fibrine is whipped out of the blood in a basin) till the whole tube of the artery is obliterated. The obliteration is sometimes accompanied with a good deal of pain. The pulse below is, of course, lost, and sometimes the limb becomes gangrenous. A similar result usually occurs in the brain, where the softening which so constantly ensues after embolism of the cerebral arteries may be looked on as a form of gangrene.

The occurrence of embolism can often be diagnosed. In the case figured on page 51 the symptoms were unmistakable, and the seat of lodgment of the clot could be exactly defined. But as a general rule nothing can be done, since the heart disease forbids any surgical treatment; otherwise there is no more reason why a limb should not be amputated for embolism than after the ligature of an artery.

Embolic clots when lodging in diseased arteries (and even perhaps sometimes in sound ones) may form the starting-point of aneurism, the vessel dilating behind the obstruction.[3]

Arteritis.

Formerly elaborate descriptions were given of the appearance of arteries when in a state of acute inflammation, and there are doubtless cases—very rare ones—in which long tracts of artery, sometimes the whole of the main arteries of a limb, have been found filled with fibrine and obliterated. Such cases are classed as instances of arteritis, and they may be so. It is, at any rate, difficult to understand them in any other way. But the descriptions of arteries acutely inflamed, with red lining membrane, &c., were no doubt mistakes, caused by confounding post-mortem staining with inflammatory injection. Little is known of acute arteritis pathologically,[4] and surgically it can hardly be said to have any importance.

Aneurism.

The term aneurism means a *tumour* formed by the enlargement of an artery. If, therefore, the word be correctly used, there must be in every aneurism an investing membrane, or sac, which communicates with the cavity of the artery, and which contains blood, either fluid or coagulated. This investing membrane may be formed either by all the coats of the vessel or by only one or two of them, or by the cellular tissue external to the artery, and the classification of the tumours is by many authors based on this circumstance. By others aneurisms are divided according to their shape and the nature of communication between the sac and the artery. Unfortunately for the intelligibility of the subject, the term aneurism is often applied to an affection in which there is no sac, and, in the proper sense of the word, no

[1] 'Med.-Chir. Trans.' vol. xxxv.

[2] Some years ago a patient was operated on for the radical cure of hernia. In passing one of the ligatures the operator had the misfortune to perforate the external iliac vein, without being aware of it. The ligature was left in the cavity of the vein, and caused coagulation of the blood. The patient died of apoplexy, which was found to have been produced by one of the clots which had passed through the heart and lodged in an artery in the brain.

[3] 'Syst. of Surg.' 3rd ed. vol. iii. p. 29.

[4] See a summary description of the changes in arteries which are referred to acute or subacute arteritis in Dr. Bristowe's 'Theory and Practice of Medicine,' under the head of 'Arteritis.'

tumour—i.e. to a subcutaneous rupture of an artery leading to the effusion of blood into the cellular tissue. This it what is often intended by a '*diffused* aneurism'—a term which in that sense should, I think, be disused, since both the pathology and treatment of such an affection differ entirely from those of common aneurism.[1]

Cause of aneurism.

The *causes* of aneurism are to be sought in anything which disturbs the balance of the circulation, so as to cause the wall of the artery to become unfit to resist the heart's action. Thus the artery becomes degenerated by atheroma, and the atheromatous portion gives way. Sometimes all the coats give way, so that the artery bursts; more usually the external coat remains entire and becomes expanded over the blood. Such commencing dilatations are constantly seen in atheromatous aortæ. At first the atheromatous patch shares in the expansion, and the aneurismal pouch is then formed by all three coats of the vessel (Fig. 243). Soon the two internal coats are worn away, and on dissection it will be found that they can only be followed a short distance from the mouth of the sac, which is then formed by the external coat only (Fig. 244). It appears certain, also, that chronic inflammation may so soften the structure of the middle coat of the vessel that it is incapable of resisting the usual force of the circulation.[2] Such chronic inflammation is believed by many pathologists to be a frequent consequence of syphilis, and the prevalence of aneurism among soldiers is thus accounted for. And again, it seems certain that the abuse of alcohol is a predisposing cause of aneurism, though whether it acts by producing arterial degeneration or by irritating the heart, and exciting it to increased action, is not clear. It seems also certain that habitual strain on the heart may act in the same way; and the use of the old stock and of the knapsack in the army, inducing a strain on all the respiratory and circulating organs, is by many army surgeons considered to have been even a more potent cause of aneurism of the aorta than either syphilis or alcohol. Violence, again, leading to a partial rupture of the artery, is an undoubted cause of aneurism. This is well illustrated by an experiment of Richerand, which I have often repeated. In the dead subject, after the rigor mortis has been completely overcome by passive motion, let the knee be forcibly overextended, till the ligaments are heard to crack. The two inner coats of the popliteal artery will often be found ruptured. And there can be no doubt that something of the kind often occurs in those sprains of the knee which are so frequently assigned as the cause of popliteal aneurism. It is a known fact that sprains and blows are frequently followed by aneurism of all kinds, and it is a frequent observation that sailors are liable to axillary and subclavian aneurism, from the sprains and injuries of the upper extremity incidental to their calling, in a proportion which as much exceeds the average as does the predisposition of soldiers to aortic aneurism. Embolism has been already mentioned as an occasional cause of aneurism. Finally, the direct wound of an artery leads to aneurism (which on that account is called traumatic), by causing an extravasation of blood into the surrounding tissues, which becomes limited and encapsuled by the areolar membrane, muscles, &c., which form the sac, the coats of the artery being traceable only a very little distance into the mouth of the sac (Fig. 246). It is well to keep these facts in view in examining a case of aneurism, since the causes which act by producing general

[1] If by 'diffused aneurism' be meant an aneurism which has burst and poured out its contents into the neighbouring parts, it would surely be better to put this into common and unmistakable English by calling it a ruptured aneurism, as it is.

[2] See Moxon, op. cit.

DIAGRAMS OF VARIOUS KINDS OF ANEURISM.



FIG. 243. True aneurism; the sac formed by all the coats.

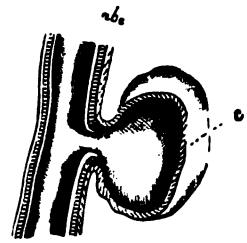


FIG. 244. 'False' aneurism; the sac formed by the outer coat only.

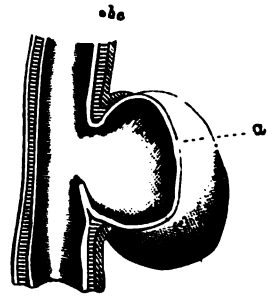


FIG. 245. 'Hernial' aneurism; the sac formed by the inner coat only.

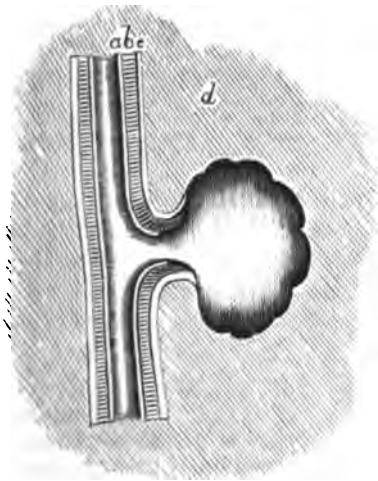


FIG. 246. Traumatic aneurism; the sac formed by the tissues around the vessel.

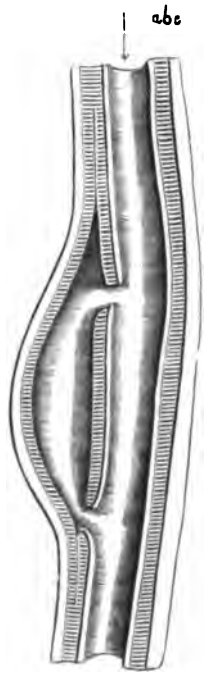


FIG. 247. Dissecting aneurism.

a, the internal coat of the artery; *b*, the middle coat; *c*, the external coat; *d*, the cellular tissue, sheath, or other tissues surrounding the artery.

arterial degeneration offer less prospect of the success of local measures than those which are more localised ; while the purely traumatic aneurism may be treated, if it seems advisable, as a wound of an artery, with the same prospect of finding the vessel healthy up to the mouth of the sac.

Classification of aneurism.

The old classification of aneurism was founded on the composition of the sac, an aneurism in which the sac is formed of all the three coats being termed *true* (Fig. 243) ; one in which the external coat only is involved, *false* (Fig. 244) ;[1] and one in which the sac is formed of the surrounding tissues, *diffused*,[2] or *consecutive* (Fig. 246).

This nomenclature is certainly neither felicitous in expression nor useful in practice. It is impossible to tell without dissection what the composition of the sac may be. The three coats of the artery can hardly ever be traced over the whole sac, except at the very commencement of the formation of aneurism, and then almost exclusively in the case of the aorta ; so that many pathologists deny the existence of ' true ' aneurism : yet the use of the term ' false ' seems to imply something exceptional in a condition which is really almost universal. It would be better to call all arterial aneurisms in which the sac is formed wholly or chiefly by the wall of the vessel *true*, and those in which it is formed wholly or almost wholly by the surrounding tissues *false* ; and many authors use the terms in this sense.

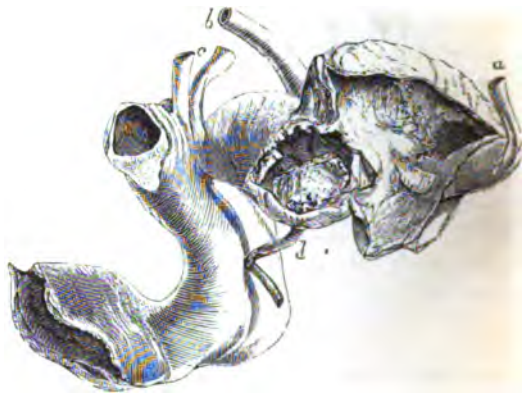


FIG. 248. Posterior view of a tubular aneurism, or aneurismal dilatation of the innominate and right subclavian artery extending from the arch of the aorta to the axillary artery. Its distal end could be felt as a round pulsating tumour in the axilla. *a* shows the axillary artery, which itself is perfectly natural ; *b*, the right carotid ; *c*, the left carotid and subclavian ; *d*, a large branch of the right subclavian (probably the internal mammary, which is hanging down and touching the arch of the aorta). The arch itself is irregularly dilated, but the root of the innominate artery is little more than the natural size. The position of the parts has been reversed, in order to show the aneurismal cavity irregularly occupied by clot.—St. George's Hospital Museum, Ser. vi. No. 204.

Another classification regards the shape of the tumour. It is very common in the aorta, and not uncommon in other arteries, to find the whole tube dilated for a very considerable extent to twice or more times its natural size (Fig. 248). This is called *aneurismal dilatation*, or *tubular* or *fusiform* aneurism, while the aneurisms which stand out from one part of the circumference of the vessel, like a bud attached to the artery by a neck, are called *sacculated*.

A still more practical distinction is, according to their apparent cause, into *spontaneous* and *traumatic*.

[1] A variety of 'false' aneurism has been described which is termed *hernial* (Fig. 245), in which the sac is supposed to be formed of the two internal coats, protruded or herniated through a deficiency in the external coat. The existence of this form of aneurism as a spontaneous formation seems, however, to be (to say the least) doubtful, though an undoubted instance of its occurrence has been reported in an artery whose external coat had been shaved in an amputation, without the tube of the vessel being cut into. It may also be artificially produced in animals.

[2] The term ' diffused false aneurism ' is, however, often used, in the other sense spoken of above, to signify a ruptured artery or aneurism.

All this refers to the true arterial aneurism. There are other conditions which are also called aneurisms, but which have only a remote resemblance to the genuine aneurismal tumours. The inner coats of the aorta, when atheromatous or ossified, may crack off and allow the passage of the blood between the external and middle coats. Dr. Peacock taught that the blood always passed into the substance of the middle coat; and no doubt it is very common for it to do so; but I believe that it is sometimes extravasated between the internal and middle coats. The blood dissects off the external from the internal part of the wall of the aorta, and has been known to proceed as far downwards as the external iliac artery. Ultimately it usually bursts through the outer coat of the artery, producing fatal hæmorrhage, and this may take place in the reverse direction to that of the circulation, so that many such cases prove fatal by rupture into the pericardium. In rarer cases the blood bursts through the internal coats, and thus makes its way back into the artery again. Such cases were described in old pathological works as instances of double aorta. The name of '*dissecting* aneurism' is given to this condition (Fig. 247). In rare cases it may be diagnosed.[1] It admits of no curative treatment. As it has hitherto only been met with originating in the aorta, it falls rather within the province of the physician, and I shall say no more about it here.

Dissecting aneurism.



FIG. 249. Copy from the portrait of a patient under Sir Prescott Hewett's care with cirsoid aneurism of the scalp, in the Museum of St. George's Hospital.—From the 'Syst. of Surg.' 3rd ed. vol. iii. p. 93.

Another condition somewhat allied to aneurism is that which is called *cirsoid* aneurism, or *arterial varix*, in which a single artery becomes dilated and elongated, very much as a varicose vein does; and closely allied to this (often, indeed, in practice, indistinguishable from it) is the condition denominated *aneurism by anastomosis*, in which there are a number of such dilated and tortuous arteries packed together. In this condition the capillaries and veins become also implicated, and many of the dilated pulsating vessels seen in such tumours, and which appear to be arteries, will be found on dissection to be really veins.

Cirsoid aneurism.

Then there are vascular tumours, or enlargements, which are formed by the communication of a diseased or injured artery with a vein—*arteriovenous* aneurism. Of these there are two kinds sufficiently distinct from each other in well-marked examples, though not always distinguishable when deeply-seated. In the first, *varicose aneurism*, there is an aneurismal tumour lying between and communicating with the artery on one side and the vein on the

Arterio-venous aneurism.

[1] See a case by Dr. Swayne, of York, in 'Path. Trans.' vol. vii. p. 106.

other, so that the two vessels open only indirectly into each other. In the second, *aneurismal varix*, the hole in the artery opens directly into the vein, no tumour whatever being present. The veins are varicose in both. They generally pulsate to some distance in the aneurismal varix, and may do so in the varicose aneurism, if the two openings in the sac are exactly opposite to each other.

The symptoms of arteriovenous aneurism are easily distinguished from those of common aneurism. When there is a tumour (varicose aneurism) it will be found to have not only a pulsation synchronous with the arterial pulse, but also a continuous thrill due to the venous stream; and the murmur is also composed of an intermittent blowing, arterial sound, and a constant rasping or thrilling bruit (compared to the snarling of a dog, or the harsh pronunciation of the letter R) caused by the meeting of the arterial and venous streams. In an aneurismal varix the bruit will be somewhat similar, varying in tone, however, with the varying condition of the orifice, and the varicose veins will pulsate. There is also commonly an increase of heat in the skin, and the hair and other epidermal tissues are over-nourished.

Treatment of these forms of aneurism.

Cirsoid aneurism is rarely made the subject of any treatment. If it be necessary to undertake its cure, the ligature of the trunk-artery leading to it, though an exceedingly uncertain measure, is, perhaps, the best. The dilated vessel itself is too much altered in structure to bear the ligature with safety, and coagulating injections are very dangerous. But when ligature of the main trunk is inapplicable resort must be had either to coagulating injections or to galvano-puncture; or if the tumour is not too large it may be extirpated. Reference may be made to what has been said above (p. 343) about the treatment of aneurism by anastomosis, to which these cirsoid aneurisms bear a very great resemblance.

Arteriovenous aneurism is very commonly the result of a wound, and in such cases the vessels will, in all probability, be healthy, if the disease is not of very long standing. But when it has existed for a long time the artery becomes so dilated and thinned above the orifice of communication that no operation on it could have any chance of success. When the disease is recent it may often be cured by pressure simultaneously exercised on the artery and on the orifice of communication. This is best done by two persons, one of whom presses lightly on the point at which the arterial stream enters the tumour, with just so much force as is necessary to suspend the cooing murmur the other compresser holds the artery at some convenient spot above the tumour, as in ordinary aneurism. If this plan fails it is best, in recent traumatic cases, to lay open the sac (having compressed the artery above or applied Esmarch's bandage) and tie the artery above and below the orifice. The veins may also be tied if it seems necessary. The artery has also been tied above and below the tumour without opening the sac, and with success.[1] The main artery and vein have also both been tied, and with success. Finally, cases have been treated successfully by coagulating injections and galvano-puncture, but these plans are less certain than surgical operation, and I believe more dangerous, and should only be used in exceptional instances.

When the disease does not cause much inconvenience, and is not rapidly advancing, it is questionable whether the patient ought to be advised to sub-

[1] By Mr. Spence. See a lecture on 'Femoral Aneurism,' in the 'Lancet,' Oct. 17, 1874. Since the publication of that paper Mr. Annandale has recorded two cases in which he laid open an arteriovenous aneurism in the thigh and in the leg, and tied both the vein and artery with success. No gangrene occurred.

mit to any dangerous treatment; and this is still more the case the more nearly the disease approaches to the form of true aneurismal varix, i.e. the less proof there is of the existence of a distinct tumour between the artery and vein.

Symptoms of aneurism.

The symptoms of arterial aneurism are as follows: There is a pulsating tumour situated in the course of the artery, and incapable of being drawn away from it; the pulsation is of a heaving character and causes an expansion of the tumour in all directions, laterally as well as up and down. It is usually accompanied by a *bruit*—a blowing or whistling sound—synchronous with the pulse. Pressure on the artery above suspends both pulsation and bruit; and if the blood in the aneurism is entirely fluid the tumour can now be almost emptied by pressure. The tumour refills in a certain number of pulsations on the withdrawal of the pressure. In some cases pressure on the artery below will cause an increase in the size or tension of the sac. The pulse in the artery below is generally much weakened, and there are various symptoms due to the pressure of the tumour on neighbouring organs, and depending, therefore, on its anatomical relations. Thus popliteal aneurism causes pain and numbness in the course of the internal popliteal nerve, and œdema of the leg from pressure on the vein; subclavian and axillary aneurism cause pain in the brachial plexus, weakness and œdema of the arm; aortic aneurism, cough, hoarseness, pain between the shoulders, and various symptoms too numerous to catalogue; in fact, each form of aneurism has its own definite symptoms, due not to its nature but to its position.

Diagnosis.

The diagnosis of surgical or external aneurism is usually, but not always, easy; that of thoracic aneurism often very difficult.[1] The reason is that in thoracic aneurisms there is very often no bruit, and the pulsation may be imperceptible, so that the pressure-effects furnish the only symptoms, and these can hardly be decisive of the nature, even if they can prove the existence, of a tumour. Even in external aneurism certain sources of ambiguity are found. A tumour of a solid or cystic consistence may lie so close to an artery as to derive pulsation from the vessel. A familiar instance is found in a cyst of the thyroid body which often touches the carotid or innominate artery, or a cyst or enlarged gland in the ham which may press upon and derive pulsation from the popliteal. But such tumours have never the definite whirr of the aneurismal bruit, even if some dull 'thud' is caused by the pressure they exert on the artery. It will be found that a similar sound can be produced by pressing the stethoscope on any large accessible artery. And they never have the expansive pulsation of aneurism—only the up and down movement communicated to them from the underlying pulsation. But the strongest sign of all is that they can usually be drawn away from the artery and then no longer pulsate. The great difficulty, however, is to distinguish between aneurism and those malignant tumours which sometimes spring from the bones, and contain large spaces which are filled with blood, and which pulsate, from the great size of the vessels opening into them. It must be admitted that in some cases the diagnosis is hardly possible, since these pulsating tumours occasionally have a bruit, lie in exactly the situation of aneurism, and their pulsation of course disappears on compression of the trunk-vessel which feeds them. In most cases of pulsatile cancer, however, there is either no bruit or one very different from that of aneurism; the bone may be felt to be expanded in the neighbourhood of the tumour; the expansion

[1] This is still more the case with intracranial aneurisms, but these hardly form part of our subject.

of the tumour is much less in proportion to its size than in aneurism, and if the case is watched, the pulsation may sometimes be found not to be constant. It has been known to disappear for a time and return again. Sometimes also flakes of bone may be felt in the coverings of the tumour. Again, there has often been found to be a practical difficulty in distinguishing between those blood-collections which are sometimes (though as I contend improperly) called diffused false aneurisms, or between aneurisms which have lost their pulsation by free rupture of the sac, and abscess. The chief diagnostic signs are the absence of inflammation of the integuments, the weakness of the pulse below the rupture, possibly coldness of the parts below, and in some cases the presence of a bruit at the point of lesion of the artery. In cases of doubt exploration with a grooved needle can do no harm, and will settle the question.[1]

Relations between the sac and artery.

The relations of the aneurismal sac to the artery are a matter of some importance. Very often a single part only of the artery has given way, although a considerable part of the vessel is, as it were, buried in the sac (Fig. 250); at other times, even in a sacculated aneurism, the whole circumference of the artery has given way, and there are two openings, one of entrance and one of exit, separated by a considerable interval (Fig. 251). This is, of course, always the case in a fusiform aneurism. The walls of the artery are by no means always diseased in the neighbourhood of the mouth of the aneurism. Still, it remains true that this part of the artery is, in a spontaneous aneurism, more likely to be found diseased than any other, and that operations on that part ought therefore to be avoided if possible.



FIG. 250. Showing an aneurismal sac in which the artery has given way at a single point, and where the artery is embedded for some distance in the tissue of the sac. This is regarded by many surgeons as the usual condition in aneurisms of the limbs.



FIG. 251. Showing an aneurism in which the whole circumference of the artery has given way for some distance, so that there are two communications between the artery and the sac, one at the upper end of the tumour, the other near the middle, from which the lower part of the artery springs. This is a very common form of aneurism, especially in the interior of the body, and represents a stage intermediate between the former figure and the true fusiform aneurism, shown in fig. 248.

Progress of aneurism.

The usual progress of aneurism is to the rupture of the sac. The tumour increases gradually; it comes into contact with neighbouring structures, which it compresses and absorbs, and which in their turn also compress and cause the absorption of the tissue which forms the sac. Thus, in thoracic and abdominal aneurisms, the spinal column is absorbed by pressure till the theca is often exposed; in popliteal aneurism the femur and the posterior ligament of the joint are worn away, &c. And as this goes on the sac softens and its tissue is replaced by the fasciæ, muscles, or bones which the sac has met

[1] See a paper 'On the Diagnosis of Aneurism,' in 'St. George's Hospital Reports,' vol. vii.

with in its progress, until it gives way and the blood exudes. This sometimes occurs by a sudden rent, the symptoms of which, if it takes place into the cellular spaces of a limb or into a joint, are sufficiently well marked. The tumour suddenly loses its pulsation and its shape, becoming flattened; a sharp sensation of a crack, or of something giving way, often accompanies this; the limb becomes swollen and cold; possibly ecchymosis may be perceptible beneath the surface. If nothing is done gangrene will probably ensue. When the rupture occurs through a serous surface it is often by a sudden crack, accompanied by rapidly fatal hæmorrhage. On mucous surfaces the bleeding is usually gradual.[1] Aneurisms do not often burst through the skin; when they do the bleeding is generally, but not always, fatal at once.

Symptoms and treatment of rupture of aneurism.

The treatment of cases of ruptured aneurism is not often successful. In the limbs the first question is whether it will not be better to amputate. If gangrene seems imminent, or there are any special features of danger in the case, this may be the best course—but in uncomplicated cases the ligature has been successfully employed, and some have even been cured by pressure. In some situations the surgeon may think himself justified in laying open the sac and seeking both ends of the bleeding vessel—and life may be, for the moment at any rate, preserved by carefully plugging the sac with sponge, lint, or other substance soaked in perchloride of iron, or in carbolic acid—or, as suggested by a recent American writer, by plugging the opening of the artery into the sac.[2] I am not aware, however, that the plugging of an aneurismal sac has ever done more than delay the fatal event.

Spontaneous cure may take place, and this in several ways. First, the aneurism may simply lose its pulsation gradually as its sac becomes more and more occupied by coagula, fresh laminæ forming concentrically till the whole sac is filled and obliterated. Secondly, the distal opening of the aneurism, or the distal portion of the artery, may become closed by an embolic clot, and this clot may gradually grow into the sac by fresh accretion till it is filled up. Thirdly, the whole sac may suppurate, the resulting inflammation may seal both portions of the artery, and the tumour may thus be extirpated, a mass of blood-clot, mixed with pus, being evacuated on the opening of the abscess. Fourthly, it is regarded as possible by many eminent surgical pathologists that the tumour may itself compress the trunk of the artery above it, and so produce a hindrance to the circulation through the sac sufficient to permit of the entire consolidation of the blood in it.

Spontaneous cure of aneurism.

Finally, it may be said that some aneurisms, or perhaps aneurismal dilatations, make no progress whatever for an indefinite time. It is common to find a dilatation of the root of the right carotid artery, which seems to remain in a stationary condition for many years, without producing any appreciable inconvenience to the patient, except a loss of the power of active exertion.

The treatment of aneurism is either internal (medical) or external (surgical). The internal treatment aims at producing a cure as in the first process of spontaneous cure above described. Its main object is to reduce the circulation by rest and low diet, and to keep the heart's action at a uniform level.[3] The rest should be *perfect*, the patient being never allowed to leave

Treatment, internal or medical.

[1] See Gairdner, in 'Med.-Chir. Trans.' vol. xlii.

[2] See Dr. Watson on a case of femoral aneurism treated by plugging the sac, 'Am. Journ. Med. Sc.' Oct. 1876.

[3] See Tufnell, 'On the Successful Treatment of Internal Aneurism,' 1864.

his bed nor to assume the erect or even the sitting posture, and everything about the bed and chamber should be carefully arranged so as to make this as little irksome as possible. The diet should be spare in quantity but nourishing in quality (say 6 to 8 ozs. of solid food, of which meat forms a good part), with as little fluid as he can be persuaded to take. A little wine is usually desirable. The object is not, as in the treatment of Valsalva, by repeated bleedings, to reduce the patient's strength or exhaust his supply of blood, but to keep the heart's action perfectly equable and somewhat below the standard of health, the pulse being between 60 and 70, and never varying, as far as that is possible. The bowels must be carefully regulated if necessary by the gentlest possible laxatives, no purging or constipation being permitted, since both involve disturbance. If it be necessary chloral may be given to procure sleep, or small doses of morphia injected. Under this plan, pursued for several months, much benefit may be obtained in the majority of cases of internal aneurism, and a few complete cures may be hoped for. As to medicines, none have as yet been proved to have any effect on the disease. Much benefit has, no doubt, in many cases followed the administration of iodide of potassium, and if it does not disagree with the general health a trial may be given to it. At the same time, I have often administered it with no effect whatever, and in cases where it has done good, as perfect rest has also been employed, it is impossible to say how much of the benefit was due to this. The iodide may be given in 5-grain doses three times a day, gradually increasing; and if the heart's action is excited a small quantity (ɱv–viij) of the tincture of digitalis or Fleming's tincture of aconite (ɱiij–v) may be combined with it. The acetate of lead has not seemed to me to act in any way beneficially.

The old operation.

The surgical or operative methods of treating aneurism are very various. The old operation (that of Antyllus) is an imitation of the cure by suppuration. It consists in cutting into the sac, turning out the clots, tying the artery above and below the tumour, and allowing the cavity to fill up by granulation. The operation is usually difficult, always dangerous, and sometimes impossible; but it has the merit that if successful it is certain to cure the disease, which is not the case with any of the others. Mr. Syme has done much to reintroduce this operation into practice; not in popliteal aneurism, in which there can be no doubt that other methods are preferable, but in some of the other forms—axillary, gluteal, iliac, and carotid.[1] When it is possible, a tourniquet or Esmarch's bandage should be applied, and then, the circulation being completely commanded, the sac may be freely split open (by a crucial incision if need be), so that its interior can be inspected throughout and the opening of the vessel clearly seen. But in some cases (as in carotid aneurism) the artery on the cardiac side of the aneurism is inaccessible. It is then necessary, in order to avoid fatal hæmorrhage, to make an opening into the tumour just large enough to admit the finger, and enlarge it if necessary till two fingers can be introduced, the opening being all the while plugged by the fingers. Then the surgeon feels around the interior of the sac till he gets his finger on the point from whence the blood is issuing. Keeping this steadily commanded, he next splits up the sac freely, turns out all the clots, and by the help of his assistant lays bare the artery above the opening of the aneurism and ties its cardiac part. This being done, he withdraws his finger, to make sure that the direct circulation is controlled; then

[1] See Syme, 'Med.-Chir. Trans.' vol. xliii. p. 137, and vol. xlv. p. 381.

dissects out the distal part of the artery and ties this also, in order to bar the reflux stream.[1]

The Hunterian operation for aneurism consists in tying the trunk of the artery at a variable distance above the aneurismal sac. French writers usually speak of this as the method of Anel; but the difference is, that in Anel's method the artery is tied close to the sac, no branch intervening, while in Hunter's it is tied at a distance, and often a great distance (as when the external iliac is tied for an aneurism of the superficial femoral), so that in the former no branch intervenes between the ligature and the sac, while in the latter often many considerable branches arise in the interval. Anel's method selects for ligature that part of the artery which is most likely to be diseased, and in that respect has no superiority over the old operation. In many cases it would be hardly possible to carry it out without wounding the sac (see Fig. 250). In fact, it is only a part of the old operation, and the latter is in most circumstances equally feasible, more certain to cure the disease, and therefore preferable. Hunter's method is an imitation of the first mode of natural cure. It does not (as might at first sight be thought) altogether suspend the circulation through the tumour, except for a very short time, but greatly diminishes it. The collateral circulation brings back the blood into the tumour certainly after the first few hours, at which time there is often enough movement of fluid in the sac to be perceptible to the hand, and very likely even sooner. In animals it has been proved by experiment[2] that the collateral circulation is restored in a very few minutes, and the same is most likely the case in the human subject. But this slight stream of blood, instead of retarding coagulation in the sac, is thought by many surgeons to promote it. Thus Broca draws a distinction between the clots which are formed by the coagulation of the blood *en masse*, such as are produced after death, containing all the solid elements of the blood, and a good deal of serum also, and which he calls *passive clots*, and the layers of coagulated fibrine mingled only with more or less of blood-corpuscles and comparatively destitute of fluid, and which he calls *active clots*, believing that the former are rather injurious than useful in

The Hunterian operation.

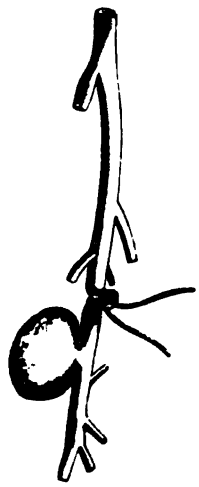


Fig. 252. Anel's operation.



Fig. 253. Hunter's operation.

[1] There are two descriptions, and only two as far as I know, of the old operation for traumatic aneurism of the carotid artery; one by Mr. Syme ('Observations in Clinical Surgery,' p. 154), and the other by Dr. Frothingham ('Am. Journ. Med. Sci.' Oct. 1876). In the latter the jugular vein was also wounded and was also tied—both patients recovered. Syme's operation was, as he says, the most arduous that he ever performed. In Dr. Frothingham's case the operation was much facilitated by division of the sternomastoid muscle—but in this case the wound in the artery appears to have been at a higher level than in Mr. Syme's case. If I understand Dr. Frothingham's description, the wound in the jugular vein, which necessitated the ligature of that vessel, occurred during the manipulation, and was not caused by the original injury.

[2] See 'Syst. of Surg.' 3rd ed. vol. iii. p. 53.

the coagulation of an aneurism, as irritating to the sac and liable to suppurate; while to the latter he attributes the active process of filling up the cavity. For the coagulation of the blood *en masse* no circulation is necessary, but for the production of laminated fibrine he believes that some amount of circulation is at least very advantageous, if not necessary. This theory, however, is refuted by the fact that when the circulation is completely commanded for a few hours by pressure on the artery under chloroform, the sac often becomes filled with coagula (which must necessarily be of the kind which Broca denominates passive), and that these very often become gradually more and more solid and a definite cure results; proving that circulation is not essential for the production of laminated fibrine, and that soft clots are not necessarily a hindrance to the consolidation of the tumour. The stress of the circulation being removed from the aneurism by the ligature of the vessel, the sac and the parts around contract upon the blood; the latter becomes gradually more and more solid, and generally no more pulsation is perceptible in the tumour. By the time the ligature has come away (see p. 88) the tumour is much reduced in size; this shrinking goes on for some time, and the tumour becomes harder as it becomes smaller, till at last only a hard kernel is left, and sometimes no perceptible enlargement remains. On dissection the sac is found filled with laminæ of fibrine much resembling the coats of an onion, entirely discoloured, if old; if tolerably recent the outer layers are perfectly buff-coloured, while the inner retain more or less of colouring matter. The artery also is usually obstructed at this part. If no considerable branch comes off between the ligature and the sac (i.e. if the case resembles Anel's operation to this extent), the whole artery from the ligature to the tumour is obliterated, and a single arch of anastomosis carries the blood into the artery below the aneurism; otherwise there are two arches of anastomosis, one to convey the blood round the portion obliterated by the ligature, and the other to convey the blood round the obliterated aneurismal sac, above which there is a pervious tract of artery (Fig. 255). The arteries forming these arches of anastomosis may be exceedingly numerous.[1]

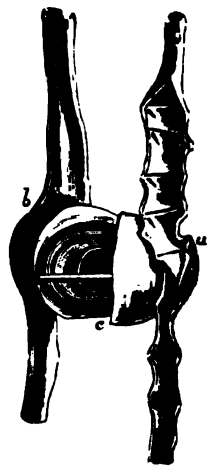


FIG. 254. A preparation showing the definitive cure of aneurism. The aneurism affected the posterior tibial artery, and the femoral had been tied some months before death. *b* shows the posterior tibial nerve spread out over the tumour, *c*; *a*, the artery, which appeared to be closed at the seat of aneurism.—St George's Hospital Museum, Ser. vi No. 129.

The main dangers which attend on this operation are those which have been spoken of as incidental to the ligature of an artery, viz., gangrene and secondary hæmorrhage (see pages 89–91); but we ought not to omit to mention that the operation may also fail in one of two ways. The more usual is the suppuration of the sac. The coagulation remains somewhat imperfect, and after a longer or shorter time—for this is very variable—the part becomes swollen, red, and painful, and an exploratory puncture will discover pus. It is well to wait till the matter has come near the surface, and

[1] See two figures (after Porta) showing the anastomotic circulation after ligature of the femoral artery ('Syst. of Surg.' 3rd ed. vol. iii. p. 52).

then to open the sac pretty freely. Usually the artery will be found to be closed; and if the patient can support the suppuration the cavity will fill up, and a cure will result: but if on opening the tumour hæmorrhage ensues, or if there be bleeding afterwards, amputation is indicated.

In rarer cases the ligature does not suppress the pulsation, or after it has been temporarily suppressed it recurs. It is not very uncommon for a little pulsation to be perceptible for a short time, which ultimately disappears; but in the cases here spoken of, as a result of too free anastomosis, the tumour returns to exactly its former condition and resumes its growth. It now becomes necessary to undertake its treatment. The first indication is to employ genuflexion or pressure both directly to the tumour and to the artery above. This failing, the surgeon must choose between the ligature of the artery lower down and the old operation. Both plans have been successfully adopted, and the choice would depend more on the individual features of the case than on any general principles. There might, of course, be circumstances which would render amputation more advisable.

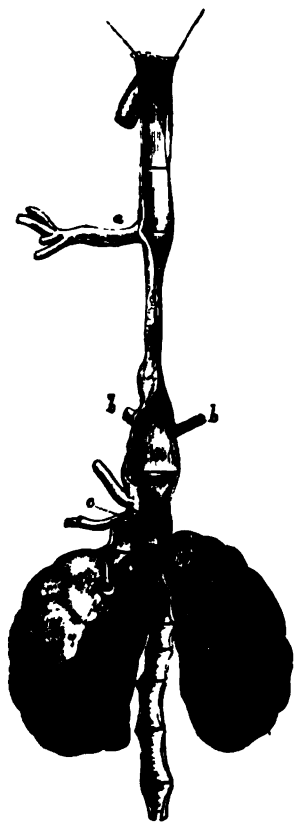


FIG. 255. A preparation showing the collateral circulation after the cure of aneurism by the ligature. The external iliac artery has been tied for the cure of aneurism of the superficial femoral. The whole length of the external iliac is obliterated, and the femoral is obliterated at the seat of aneurism. *a* points to the internal iliac, the branches from which and from the aorta have anastomosed with *b b*, the two branches of the external iliac, as well as with those of the profunda, *c*, and thus have brought the blood into the common femoral, which is enormously enlarged, so as to equal in size the common iliac artery. Again, the branches from the profunda have communicated with the superficial femoral, which is pervious from a point immediately below the aneurism. St. George's Hospital Museum, Ser. vi. No. 120.—From the 'Syst. of Surg.'

Distal ligature.

The distal ligature after the methods of Brasdor and Wardrop is a method of treatment which is now restricted to aneurism at the root of the neck, and which will be discussed on a subsequent page in treating of that form of aneurism.

Constriction or temporary ligature of arteries.

The application of a temporary ligature, or of a constrictor to arteries in their continuity bears considerable resemblance to acupressure, and in fact acupressure has been used for the same purpose, but as far as I know unsuccessfully. Mr. Dix's wire compress, however,[1] and Dr. Fleet Spiers's artery constrictor,[2] are said to have been used with success. The object of this plan is to constrict the artery so forcibly for a time as to obliterate it, probably by rupturing its internal coats, whilst the external coat is left entire, so that no secondary hæmorrhage can occur. For my own part I cannot but regard the carbolised catgut or animal ligature as a safer agent and more likely to attain the object proposed, though Dr. Fleet Spiers's invention is said to have been successfully applied to all the great arteries in the body. Mr. Bryant lately used this instrument with success in a case of popliteal

[1] 'Med. Times and Gaz.' 1863, vol. i. p. 94.

[2] 'New York Arch. of Clin. Surg.' vol. i. p. 96.

aneurism. The case, as related to the British Medical Association, and the discussion on the subject, will be found in the 'Brit. Med. Journ.' Oct. 14, 1882, pp. 721 and 784.

Compression treatment of aneurism.

Pressure on the artery above has now become a recognised method of treating aneurism, and on the whole has been very successful. There are many ways of doing this, amongst which I have no hesitation in saying that compression with the finger is far the best, when it can be carried out. But it must be recollected that pressure cannot be expected to succeed unless it is regular, efficient, and equable. Irregular pressure, which allows the sac to re-fill frequently, cannot but aggravate the disease by perpetual disturbances both of the sac and its contents, and causes distress and pain to the patient. Whatever form of pressure, therefore, is selected, care should be taken to ascertain by constant supervision that during the whole of its application, no circulation is perceptible through the tumour.[1] And it is well not to commence the treatment until, by a few days of complete rest and low diet, the circulation has been brought down to the level of health or below it, and until, as Dr. Carte suggested, a weight of about 8 lbs. laid on the artery in the groin (taking the case of popliteal aneurism) will stop the circulation in the tumour. Then, if digital pressure is to be used, a staff of assistants must be organised, who are to take charge of the artery in pairs, one holding the artery while the other keeps his hand on the tumour, to see that the pressure is effectual. Without assistance a man can hardly command the femoral artery completely for more than ten minutes, but the compressor's fingers can be much assisted by a weight or bag of shot made to fall upon the end of the finger.[2] In this way it is said that the same person can maintain compression for an hour. In changing the compresser care should be taken that the artery does not escape even for an instant. The process is often by no means painful, and a very rapid cure is in some instances obtained.[3] In other cases the pressure must be intermitted, in order to give the patient needful repose during the night, and resumed next morning. So long as the case goes on well—i.e. if the pulsation and size of the tumour are obviously diminishing—the treatment should be continued; but if no impression whatever is made on the disease I do not think it is wise to persevere beyond the first few days, at least in those forms of aneurism where (as in the popliteal) the operation of ligature is easy and involves comparatively little danger.

In cases where the artery lies too deep for digital compression it may be compressed manually by means of a pad mounted on a handle. A very useful instrument for this purpose was devised by the late Mr. Coles, which has been successfully employed in the compression of the carotid

[1] When compression was first introduced into general use surgeons were a good deal under the influence of the theory which Broca has so strongly advocated, and only aimed at reducing, not stopping, the circulation. I believe I am correct in saying that this plan is given up even in France since the great success which has been proved to attend on digital pressure in the practice of Vanzetti and others. For digital pressure is always applied so as to stop the circulation altogether.

[2] See Holden, in 'St. Bartholomew's Hospital Reports,' vol. viii. p. 140. A similar plan has been proposed by a French surgeon. In a case recently under my care the compressor found relief by leaning the opposite elbow on the compressing fingers.

[3] The most rapid cures are one of femoral aneurism, under the care of Mr. Darke of Salisbury, cured in 1½ hours; one (popliteal), under Dr. Blackman, in three hours; and one under Vanzetti's care in 2½ hours. On an average it is said that cases of popliteal aneurism are cured by digital pressure in three days, and by instrumental in fourteen.—'Lancet,' May 8, 1875.

artery.[1] A small pad, about the size of the end of the finger, is mounted on a rod fixed in a tubular stem, with a spring so that the pad does not exercise completely dead pressure.

Instrumental compression is most easily made by means of a weight suspended from a frame, which can be improvised out of any materials that happen to be at hand, or the weight may be held by the patient or an attendant. The end of the weight ought not to be much larger than the finger, in order to avoid as far as may be the simultaneous compression of the vein or any of the neighbouring parts. But in this, as in all other forms of compression, the most careful and continuous supervision is necessary. It is obvious that any sudden movement of the patient's body may entirely displace the whole apparatus, and a few moments' negligence may undo the effect of hours of compression. Still, many cases, especially of femoral and popliteal aneurism, have been successfully treated in this way. The femoral artery in the groin is peculiarly well situated for this form of treatment.

Numerous more elaborate instruments have been devised; modifications of the Italian or horseshoe tourniquet (Signorini's), which compresses the artery by means of an arm carrying a pad, and supported on a plate moulded to the opposite side of the limb. The pad is movable, either by a joint or by a screw. The best form, I think, is Carte's compressor, in which the arm which carries the pad is mounted on a universal joint, and is supported by stout indiarubber springs, so as to be somewhat elastic without shifting. But the great success of digital pressure has much restricted the application of these instruments, and I think it unnecessary to describe or figure their various forms. The reader will find them figured in Broca's work on Aneurism, or in the illustrated catalogues of the instrument-makers.

The advantages of the digital over the instrumental form of pressure are that it involves less risk of compressing the vein along with the artery, a drawback which is inseparable from instrumental compression; that it is less likely to ulcerate the skin; that the minimum of pressure necessary for the purpose is more easily ascertained; and that it is more easy to shift the point of its application to one at a short distance, so as to give relief to the skin at the point first compressed, yet not change to a different part of the artery.[2]

The advantage of instrumental over digital pressure consists in its requiring no numerous staff of trained assistants; but it does require the constant supervision of at least one well-trained and competent attendant, and is much more likely to succeed when that attendant is the surgeon himself. It very often fails from being left to students, nurses, &c., who direct the pressure wrongly or use it too severely.

The cure of aneurism by pressure is generally preceded by enlargement of the neighbouring collaterals, arteries being felt pulsating in situations where normally no artery is perceptible, and it is often accompanied by very severe pain in the part, which sometimes is so agonising that the patient declares

[1] 'Lancet,' June 14, 21, 1873.

[2] Mr. Walker of Liverpool insists, and I think with some reason, on what he calls 'the one-artery system' of pressure. That is to say, for instance, in popliteal aneurism the pressure is always to be applied either to the common or to the superficial femoral. In changing from the one to the other the system of collateral vessels is also changed, and the course of the cure interrupted. In the instrumental form of pressure it is almost always necessary to shift the pad a considerable distance; not so in the digital.—See Walker, in 'Liverpool Med. and Surg. Reports,' vol. v., and 'Lancet,' May 8, 1875, p. 639.

he can bear the pain no longer, and desires that an operation may be at once performed.[1]

'Rapid' pressure.

Another method of attempting the cure of aneurism by pressure is by what is called 'rapid' pressure, i.e. the endeavour to keep the circulation entirely stopped for as long a time as may be necessary to fill the sac with clot, in the hope that definite coagulation will follow on this. Generally speaking, the proceeding is too painful to be endured without anæsthesia, and for this purpose a patient has been kept under the influence of chloroform sufficiently to bear the pressure for as many as fifty-two hours,[2] being permitted to recover consciousness at intervals just enough to allow him to swallow. The plan has hitherto been carried out chiefly in aneurisms of the abdomen and thigh, by compression of the aorta or one of the iliac arteries. Where the vessels are more accessible to pressure, or where their ligature does not involve very great danger, it seems very doubtful whether it is justifiable to resort to it. The pressure has in all known cases been applied by some form of tourniquet. Further particulars will be found under the head of Abdominal Aneurism.

Genu-flexion.

Flexion of the limb has often proved successful in the treatment of popliteal aneurism. It has been used also with success, I believe, in the treatment of aneurism at the bend of the elbow, and has been tried in femoral aneurism, but, as far as I can ascertain, with no definite results.[3]

Genuflexion acts by retarding the circulation much as compression of the artery does, and also, as I believe, by displacement of clot and by direct pressure on the parts, including, perhaps, the artery above the tumour, as in our fourth mode of spontaneous cure (p. 535). It need not be enforced to an extent which is either painful to the patient or likely to injure the tumour, and if not speedily successful should not be long persisted in. The simplest cases are the best suited for it. More will be said on this subject under the head of Popliteal Aneurism.

Manipulation.

Manipulation of the tumour was introduced into practice by Sir W. Fergusson, in order to imitate the second mode of spontaneous cure above described. The object of the manipulation is to press the two walls of the aneurism together, and so far to displace some of the coagula which are contained in it that they may either be carried into the distal mouth of the aneurism or at least project into the blood-stream and form a starting-point of renewed coagulation. It has been employed with success in popliteal, femoral, carotid and subclavian aneurisms, and is an undoubtedly justifiable measure in tumours which cannot be operated on without very great danger, which are not near to bursting, and in which there is evidence of the formation of bloodclot.

Compression by Esmarch's bandage.

Lately the use of Esmarch's bandage has been introduced for the cure of popliteal aneurism by Staff Surgeon Reid,[4] and it has undoubtedly succeeded in some cases, including the one originally so treated—though in others it has failed and often apparently produced harm. It is a combination of direct

[1] See Mr. Campbell De Morgan's case, related in the 'Syst. of Surg.' 3rd ed. vol. iii. p. 41.

[2] Mr. Holt's case, in 'Clin. Soc. Trans.' vol. vii. p. 56.

[3] A case of Dr. Gordon Buck is always quoted in the books as a successful adaptation of flexion to femoral aneurism. A reference to the original ('Amer. Jour. Med. Sc.' 1870, p. 69) will show that the case was merely one of temporary return of pulsation after cure by compression, and that the effect of the flexion was to exercise direct pressure on the sac. It bore very little resemblance to a recent case of aneurism.

[4] 'Lancet,' 1875, vol. ii. p. 448.

pressure, pressure on the artery above, and manipulation, and it is obvious that it must entail a good deal of danger, and should be used only for a limited time and only after the other and milder methods have failed. The results of this treatment, as far as they are known at present, have been collected by Mr Gould, in the 'Transactions of the International Medical Congress,' and by Dr. Stimson, in the 'Am. Journ. Med. Sc.' April 1881. In both lists the cures are a little above half the number of cases, and in nearly all digital or instrumental pressure has been combined with the bandage. The method usually adopted is to apply the bandage tolerably firmly on the lower part of the limb, very lightly over the aneurism, and again more firmly above, with the elastic cord. It seems hardly safe to prolong the application beyond two hours, and pressure ought always to be kept up on the artery above for a few hours after removing the bandage. The dangers are from rupture of the sac, from gangrene, and perhaps, as Mr. Gould thinks, from increase in the blood-pressure in the heart or large arteries, in consequence of the displacement of the blood from the limb. It should never, in my opinion, be used except as an adjunct to digital or instrumental pressure, and after an unsuccessful trial of these means without it. It seems to cure, partly by producing coagulation of the blood in the sac, and partly by displacement of clot, and impaction in the mouth of the aneurism,[1] and it should never be used when the parts around the aneurism are inflamed, or when the tumour is of large size or seems at all likely to burst. In such cases the ligature ought to be employed at once.

Coagulating injections.

The injection of coagulating fluids (generally the perchloride of iron, about 25 per cent. of the salt) has been occasionally used with success; but it can only be rarely useful in arterial aneurism, since in order to be employed with safety it requires that the circulation should be commanded above the tumour, i.e. that the case should be amenable to ligature or pressure, which therefore are generally indicated, as the injection is neither free from danger nor by any means certain to cure the disease.

Galvano-puncture.

Electricity may also be employed to coagulate the blood in the sac. A weak stream of galvanic electricity passed through the blood will be found to decompose it, hydrogen being disengaged at the negative and oxygen at the positive pole, and in this way coagulation may be commenced, which under favourable circumstances will go on until the sac is completely filled; but the method is a very uncertain one, and is liable to failure from the melting down of the soft clot which may have been formed, or it may prove fatal by setting up inflammation of the sac, or by causing sloughing around the needle-punctures, followed by hæmorrhage.

Introduction of foreign bodies.

Finally, it has been proposed and attempted to produce coagulation in the sac by the introduction of foreign bodies into the blood which is circulating through it—much in the same way as the fibrine is whipped out of blood in a basin by a bunch of twigs. Mr. Moore[2] originated this method of treatment by introducing a large quantity of iron wire into the sac of an aortic aneurism. Considerable coagulation was produced, but the wire caused fatal inflammation of the sac-wall. Dr. Murray of Newcastle tried carbolised catgut, but without result. Recently horsehair has been used, by Dr. Levis of Pennsylvania, in a case of subclavian aneurism, and by Mr. Bryant in one of popliteal aneurism, and also with the effect of producing a good deal of

[1] See the drawing of an aneurism cured by this method under Mr. Wagstaffe's care. 'Path. Trans.' vol. xxix.

[2] 'Med.-Chir. Trans.' vol. xlvii. p. 129.

coagulation.[1] Both cases, which were of a very unfavourable nature, ended fatally; but it does not appear that the foreign body caused any injury to the sac or other parts in either, and the experiment may be worth repeating in a case which is not amenable to more hopeful measures. I have spoken above (p. 585) of plugging the sac or artery as a method which may be sometimes useful in averting death from rupture of an aneurism. But treatment which acts only on the blood in the sac holds out comparatively little hope of success. The really successful methods of treatment—rest, ligature, and pressure—are assisted in their operation by the reaction of the tissues around and of the sac itself. The weak point in the treatment by manipulation, coagulating injections, galvano-puncture and the introduction of foreign bodies is, that these methods either tend to injure or to produce inflammation of the sac-wall.

Thoracic aneurism.

A short exposition of the chief kinds of surgical aneurism is necessary here, to which I shall append a description of the operation of tying each artery.

Aneurism of the arch of the aorta can only very rarely be made the subject of surgical treatment, but the surgeon should be acquainted with its main features, in order to diagnose it from other diseases, as well as to distinguish those rare cases in which operative treatment may be justifiable. Bruit is very frequently absent in thoracic aneurisms, which are often of the tubular variety, or open into the artery by a wide, unobstructed orifice.[2] The pulsation also is often imperceptible, so long as the thoracic parietes remain intact, and it may be simulated by pulsation communicated by the heart to a cancerous or other tumour.[3] Consequently the diagnosis often rests more on the indirect than the direct symptoms. These are usually pain between the shoulders from pressure on the spine, ringing cough from pressure on the trachea, spasmodic dyspnœa, either from pressure on the recurrent nerve or on the windpipe itself, dyspnœa, hæmoptysis, and inequality of the pulse in the wrists and sometimes also in the carotids. Very commonly one of the large branches given off by the arch is so obstructed that no pulse can be felt in its branches.

Thoracic aneurism is, as a rule, best treated by the internal or medical treatment described on p. 585. Under this plan of treatment almost every case of thoracic aneurism, and many cases of aneurism of the limbs, will rapidly improve; and in some rare cases even of aortic aneurism a complete cure may possibly be obtained. The only surgical measures which are admissible in aortic aneurism are either galvano-puncture or the ligature of the carotid, or of the carotid and subclavian simultaneously on Brasdor's method. Galvano-puncture is, as far as our present knowledge extends, an uncertain and a dangerous measure, which, however, has yielded some good results in the skilful hands of Signor Ciniselli and others. Distal ligature seems to me to be useful or justifiable only in aneurisms believed to implicate the transverse portion of the arch and to be extending along the course of the carotid into the neck, in which case the corresponding artery (generally the left carotid) may be tied, and this has been done by Mr. C. Heath in one well-known case with very considerable benefit. The patient, an agricultural labourer, under Dr. Cockle's care, remained in good health for about four

[1] The preparation from Mr. Bryant's case is in the Museum of Guy's Hospital.

[2] On the other hand, I have known the bruit so loud as to be heard all over the room.

[3] See a case reported by me in the 'Path. Trans.' vol. ix. p. 29.

years after the operation, and earned his bread by field-work. The tumour then began to grow and proved fatal.[1]

Innominate aneurism.

Aneurism of the innominate artery is difficult to diagnose from aortic aneurism, and many cases, under the care of the best surgeons, are on record, in which supposed innominate aneurisms have on dissection turned out to have been purely aortic. It forms a pulsating tumour near the right sterno-clavicular articulation, pushing the upper part of the sternum forwards, often dislocating the end of the clavicle or eroding it, and usually first presenting in the interval between the tendinous and muscular origins of the sterno-mastoid. More or less dyspnœa may be present from pressure on the trachea, and the pulse in the right wrist is generally much feebler than in the left. The other symptoms will vary with the size of the tumour.

In innominate as in aortic aneurism it is desirable to avoid surgical measures if possible, since no operation can be practised without very great danger, and the prospect of success or even of benefit is very slight. But if the tumour be extending, in spite of the treatment by rest, and especially if it be extending along the trachea, as evidenced by its growth and by the increase of dyspnœa, it is, in my opinion, quite justifiable either to try galvano-puncture, or to tie the right carotid on Brasdor's method, or even, perhaps, to tie the subclavian artery as well.[2]

The reader will find the subject of distal ligature for aneurism at the root of the neck and in the thorax fully discussed, and all the cases which I had then met with tabulated in my article on 'Aneurism' in the third edition of the 'System of Surgery,' vol. iii. pp. 116 to 124.

Carotid aneurism.

Aneurism of the carotid artery is generally situated at the bifurcation of the common carotid. It may, however, affect the common trunk lower down, or one of the secondary carotids, generally the internal. The diagnosis is usually easy, but the lower down the tumour extends the greater is the difficulty in distinguishing it from aortic aneurism;[3] and cases have

[1] On the subject of thoracic aneurism I would refer the reader for details and discussions, for which I can find no space here, to a series of lectures published in the 'Lancet' for June and July 1872; also to a very successful case of distal ligature of the left carotid, some particulars of which I published in the 'Clin. Trans.' vol. ix. (the patient was heard of a short time since as being alive and in domestic service), to Mr. Barwell's papers in the 61st and 62nd vols. of the 'Med.-Chir. Trans.' on simultaneous ligature of the carotid and subclavian artery for aortic aneurism, to his treatise on *Aneurism*, and to Dr. Wyeth's article in the 'Am. Journ. Med. Sci.' Jan. 1881.

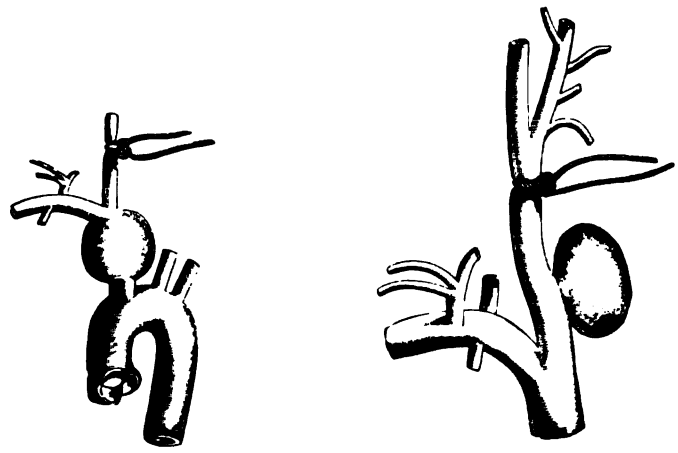
[2] As I have myself tied the subclavian (third part) and the carotid simultaneously in a case of innominate aneurism, I need hardly say that I think the distal operation justifiable in appropriate cases of this affection. But I must say that the study of my own case and of the published records of the others has led me to the decided conviction that the benefit which has been obtained in some of them has been due usually to the ligature of the carotid, by which the carotid or tracheal portion of the sac has been obliterated; and I should be disposed in any future cases to commence with the less severe measure of tying the right carotid. It must be remembered that the large branches from the first part of the subclavian must carry on the collateral circulation after the third part of that artery has been tied; and for this purpose the circulation must go on through the sac into the first part of the subclavian artery, and probably with increased force, after the operation, so that the entire obliteration of the sac by the distal ligature seems impossible unless the first part of the subclavian could be secured inside its large branches, which, up to the present time, has been found incompatible with the patient's recovery, even without the complication of ligature of the right carotid. Still Mr Fearn's case, where a practical cure certainly resulted (a channel about the size of the original artery being maintained through the clot which filled the aneurism), is an encouragement for tying the two arteries either simultaneously or, perhaps better, with an interval, as in that case.

[3] See the well-known case under Sir A. Cooper's care in Allan Burns, 'On the Surgical Anatomy of the Head and Neck,' pp. 60 et sqq.

been recorded here, and in other regions of the body, where either an abscess pressing on the artery, and receiving pulsation from it, has been mistaken for an aneurism, or, *vice versâ*, an aneurism has been mistaken for an abscess; but I do not know that the danger of mistakes is greater here than elsewhere.[1]

Brasdor's and Wardrop's operations.

An aneurism of the common carotid low down in the neck, or an aneurism of the intrathoracic part of the left carotid (if the latter affection ever occurs, of which, as far as I know, no instance exists at present), may be treated with good prospect of success by Brasdor's operation; and it is to these aneurisms, as Hodgson and Wardrop have clearly shown, that Brasdor's operation is in strictness applicable; and a good augury of its probable success in such cases is given by the fact—which Wardrop noticed with surprise in a case in which he had tied the artery beyond the aneurism—that the tumour collapses immediately the artery is tied, instead of increasing in tension and pulsation, as it would do if the stream of blood pumped in from the heart were not derived



FIGS. 256 and 257. The former shows Wardrop's operation, i.e. the ligature of the carotid artery for aneurism of the innominate. Wardrop's idea seems to have been that as the quantity of blood conveyed by the carotid, that by the branches of the first part of the subclavian, and that by the third part of that artery, may be taken to be about equal, he could deprive the sac of one-third of its blood by tying the carotid, and of two-thirds by tying the third part of the subclavian also. He had not allowed for the increase of the collateral circulation.

FIG. 257 shows Brasdor's operation as applied to an aneurism limited to the trunk of the carotid, the only situation in which this operation can in strictness be applied.

I have shown reasons for believing that when these operations succeed they do so, not so much by retarding the blood-flow through the tumour as by the extension of coagulation from the tied artery into the aneurismal sac.

down the collaterals, which at once begin to enlarge. It is possible that some aneurisms seated low down on the carotid might even be cured by distal compression, but no case is at present recorded.

Aneurisms seated near the bifurcation or in one of the secondary carotids or their branches may be treated either by the old operation, by the Hunterian ligature, or by compression. The first method has been described above. Compression of the common carotid is not an easy thing either to perform or to endure; nevertheless at least five successful cases have been published.[2] It may be effected either by the finger, by an apparatus with a movable arm carrying a small pad, or by Coles's compressor. The point against which the carotid is most easily compressed is the anterior tubercle of the transverse

[1] Traumatic aneurism of the vertebral artery has also been mistaken for carotid aneurism. On this subject see a lecture published in the 'Lancet,' July 26, 1873.

[2] See 'Lancet,' June 21, 1873.

process of the fifth cervical vertebra, which lies almost two inches above the clavicle, and is called sometimes 'Chassaignac's tubercle,' since that surgeon first drew attention to the comparative ease with which the artery could be compressed there.

Ligature of the common carotid.

The common carotid may be tied in any part from the root of the neck to the bifurcation, and either of the secondary carotids are accessible as high as the parotid gland. The 'lieu d'élection' for the ligature of the common trunk is just above where it is crossed by the omohyoid muscle, i.e. at the level of the cricoid cartilage. An incision is made with its centre at this level, and in the course of the vessel (i.e. in a line from the sternoclavicular articulation to the point midway between the angle of the jaw and mastoid process), its length being proportioned to the size of the neck. After the skin platysma and deep fascia have been divided the edge of the sternomastoid is seen, and the upper belly of the omohyoid may be noticed passing upwards and inwards. Then the operator searches for the sheath of the vessels, lying close on the trachea, and having the descendens noni nerve generally in front of it. Having opened the sheath, the pulsation and the colour of the artery will be recognised. Then it is to be cautiously separated with the director and the point of the knife from the sheath and the vein, for a very short distance, so as to allow the needle to be got round it. Compression of the bare artery between the finger and the needle will stop the pulsation in the tumour, or, if the operation be on the distal side of the aneurism, will stop the pulse in the temporal artery; and this experiment should never be neglected, for very good surgeons have been so deceived by pulsation communicated to a piece of fascia as to tie it instead of the vessel.



Fig. 258. Ligature of the common carotid artery. The edge of the sternomastoid muscle is seen with a double blunt hook passed under it. B shows the carotid artery, with a ligature passed round it. The sheath is shown opened, and on the sheath may be seen the descendens noni nerve. Crossing the sheath is the omohyoid muscle, A. The opening in the sheath is represented larger than it would be made in practice, in order to show the jugular vein external to the artery, and the pneumogastric nerve between the two vessels and posterior to them. In practice, however, the nerve ought never to be exposed; and the jugular vein, unless it is distended, is usually not brought into view.

The lower part of the carotid is more deeply seated, and in tying it it is better to divide the sternomastoid freely enough to expose fairly the sternohyoid and sternothyroid muscles. These muscles should then be carefully divided on a director, when the sheath will be exposed. In tying the carotid the jugular vein and pneumogastric nerve are not usually seen, but either of them may be, especially the vein, which is sometimes swollen and laps over the artery, so as to give some trouble. At the root of the neck, on the right side, the vein is separated from the artery by an interval, while on the left side it somewhat overlaps the artery. The sheath of the vessels near the root of the neck is usually covered by several veins descending from the thyroid body, which increases the difficulty of the operation. The ligature should always be passed from without inwards.

Ligature of the common carotid has hitherto proved fatal in about 40 per cent. of the cases operated on. Dr. Pilz has tabulated 600 miscellaneous cases in the 9th vol. of Langenbeck's 'Archives,' with 259 deaths. But the danger seems to depend more on the patient's general condition than on the intrinsic severity of the operation, the great mortality being in cases where the artery has been tied for hæmorrhage. In ordinary cases the death-rate is estimated at about one-third.[1]

Ligature of the external carotid.

Ligature of the internal carotid is not an operation usually performed, except as a dissecting-room exercise;[2] but the external carotid has often been tied,[3] in the following manner: Make an incision downwards, from a little external to the angle of the jaw to near the anterior edge of the sterno-mastoid, from one-third to half an inch below the upper border of the thyroid cartilage; dissect away some cervical glands and the venous branches connected chiefly with the facial and lingual veins, which lie over the artery. The glands should not be torn away or lifted, for fear of tearing the veins, to which they adhere closely, but freely incised, and the veins tied and divided if necessary. Then look for the hypoglossal nerve, which crosses the artery perpendicularly, and will serve as a guide to the vessel lying immediately beneath. There is usually about half an inch of the trunk available for the purpose of placing the ligature, between the origin of the superior thyroid, which is generally close to the bifurcation, and that of the lingual, facial, and occipital above. The identity of the vessel may be known by its relation to the hypoglossal nerve, the presence of a collateral (the superior thyroid), when it happens to come into view, and the fact that pressure on the exposed vessel commands the pulse in the temporal.[4]

Ligature of the lingual and thyroid arteries.

Some of the branches of the external carotid have been tied. The lingual is the one most frequently operated upon, and mainly on account of hæmorrhage from cancer of the tongue. An incision is made, having its centre opposite the great cornu of the hyoid bone, and either horizontal or downwards and forwards, at an angle of 45°. The superficial parts and the deep fascia having been divided, the operator seeks for the ninth nerve, which runs superficial to the hyoglossus muscle, while the artery crosses beneath the nerve to pass under that muscle.[5] One plan is to draw the nerve aside and tie the vessel as it plunges under the muscle; the other is to divide the fibres of the hyoglossus from the bone and look for the artery, lying parallel to the upper border of the hyoid bone. It must be remembered that the artery varies in its origin, and in its course external to the cornu of the hyoid bone, so that it is sometimes very difficult to find it in the first portion of its course.

As to the other arteries in the neck I may quote the following directions:—

'For the superior thyroid an incision is to be made, two inches long, parallel to the inner margin of the sternomastoid, its centre corresponding to the great cornu of the thyroid cartilage. This brings into view the omohyoid muscle and the sheath enclosing the jugular vein and common carotid; the fibrous lamellæ which cover the artery having been torn away

[1] 'Syst. of Surg.' 3rd. ed. vol. iii. p. 130.

[2] In a case of distal ligature a short time ago, where the parts were much changed in position by the growth of the aneurism up the neck, I tied the internal carotid artery by mistake.

[3] M. Guyon quotes twenty-four cases in the 6th vol. of the 'Mém. de la Soc. de Chir. de Paris.' See also Cripps in 'Med.-Chir. Trans.' vol. lxi.

[4] 'Syst. of Surg.' vol. iii. p. 131. 3rd ed.

[5] See 'Heath's Operative Surgery,' Pl. V.

with a director, the superior thyroid may be found running downwards between the main vessels and the thyroid gland; or, if the facial is the artery sought for, it can be found by the same incision, the search being conducted upwards towards the jaw, where the artery is found between the great vessels and the submaxillary gland.

'The inferior thyroid is to be sought by an incision similar to that for the carotid in the lower part of the neck. It is usually concealed by the upper part of the omohyoid muscle. This muscle must therefore be depressed or divided, and the artery sought for between the trachea or œsophagus and the trunk of the carotid. The recurrent nerve and the descendens noni will be endangered in this operation.'[1]

Orbital aneurism.

Orbital aneurism is a rare disease, i.e. pulsating tumour in the orbit is rare, and true aneurism is still rarer. The case which first attracted the notice of the profession was published by Mr. Travers[2] as one of aneurism by anastomosis, but it is now conceded on all hands that most of the cases of pulsating tumour in the orbit are certainly not of this nature, although we may still admit the occasional occurrence of aneurism by anastomosis here, distinguished by its appropriate symptoms.[3] But the objections to regarding the ordinary cases of pulsating tumour in the orbit as aneurisms by anastomosis are irresistible. Mr. Nunneley, in two most interesting papers on pulsating tumours in the orbit,[4] succeeds, I think, in proving this point, since 'aneurism by anastomosis involves all the neighbouring vessels, arteries, and veins in active disease; aneurism of the orbit is generally limited to a single part, or if the neighbouring vessels are dilated they seem only enlarged from obstruction—ligature of the trunk of a vessel leading to an undoubted aneurism by anastomosis is an extremely unsuccessful operation; in aneurism of the orbit, a very successful one—finally, the cases dissected have turned out to be common aneurism.'

But that some of these tumours are not arterial aneurisms seems clear enough, from a tract published by M. Delens[5] recounting two cases under the care of Nélaton, in both of which the disease was found to consist in a communication between the internal carotid artery and the venous channel in the cavernous sinus; and again, Mr. Bowman's case (published in Streatfeild's 'Ophthalmic Reports,' April 1859) shows that all the ordinary symptoms of what is called 'orbital aneurism' may be caused by coagulation of blood in the venous sinus pressing on the carotid artery and occasioning protrusion of the eyeball.

The symptoms of 'orbital aneurism' (so-called) are protrusion of the eyeball, eversion of the lids, loss of vision, and pulsation; sometimes in the form of a definite rounded tumour above the eyeball, sometimes as a general pulsation, perceptible throughout the orbit.

In cases which have been followed to their conclusion uninfluenced by treatment it has been found that the tumour will sometimes subside entirely without any permanent mischief,[6] or in some cases with loss of vision, in

[1] 'Syst. of Surg.' 3rd ed. vol. iii. p. 132.

[2] 'Med.-Chir. Trans.' vol. ii. See also another case, by Mr. Dalrymple, in vol. vi.

[3] See Haynes Walton, 'Surg. Dis. of the Eye,' 2nd ed. 1861, p. 230.

[4] 'Med.-Chir. Trans.' vols. xlii. and xlviii.

[5] 'De la Communication de la Carotide interne et du Sinus Caverneaux,' Paris, 1870.

[6] Erichsen, 'Science and Art of Surgery,' vol. ii. p. 28. Holmes, 'Am. Journ. of Med. Sci.' July 1864, p. 44.

consequence of the long exposure of the protruded eyeball;[1] and this is in itself a strong presumption against the presence in such instances of arterial aneurism, and a strong argument against the too early resort to any serious surgical operation.

The appearances on dissection have also been very various. In some cases it is said that an ordinary encysted aneurism of the ophthalmic artery has been found,[2] whether in the orbit or in the sella turcica.[3] In other cases, as in those reported by Dr. Delens from Nélaton's practice (op. supr. cit.) there has been a communication between the internal carotid and the venous channel of the cavernous sinus (arteriovenous aneurism), and in these the pulsating tumour over the eyeball has been proved to have been formed by a dilated and pulsating vein; in others, again, nothing beyond a collection of bloodclot (thrombosis) in the sinus pressing on the artery (as in Bowman's case).

For these reasons surgeons are now less quick than they used to be to resort to the ligature of the carotid artery in such cases. It is better at first to watch the case; and if no great inconvenience is caused by the disease it is very doubtful whether any treatment is necessary; otherwise digital pressure on the carotid artery as long and as frequently as the patient can tolerate it, is advisable. If, in spite of this, the symptoms are advancing, the choice lies between injection of perchloride of iron and ligature of the carotid.[4]

Subclavian aneurism.

Subclavian aneurism is a very formidable and fatal disease; like all other aneurisms near the heart, it is usually fatal if left to itself, while surgical treatment generally only hastens death. The only really successful methods of treatment in aneurism are those in which the surgeon deals, not with the blood or the contents of the sac only, but also with the sac itself and the tissues which surround it: by taking away the eccentric pressure of the blood on the walls of the sac, the latter are allowed to react on the contained blood, and this is a powerful aid in the cure of the disease. On the other hand, a softened, inflamed or ruptured sac is usually the precursor of death when the tumour is near the heart. Now, in aneurism of the first or second part of the subclavian artery the ligature can only be applied to the innominate artery, and in aneurism of the third part of the right subclavian to the first part of the same vessel; and both operations have proved uniformly fatal, except in one case, in which the innominate and subsequently the vertebral artery were tied by Dr. Smyth of New Orleans, and the patient survived after several severe attacks of secondary hæmorrhage. Galvanopuncture may be tried, but its effect is so commonly to set up inflammation of the sac that it must always be doubtful whether it is not more dangerous than abandoning the case to nature. The 'manipulation' of the tumour remains as the only active surgical measure; and this, though perfectly justifiable, and indeed indicated, when the sac contains a good deal of clot in one part, but is growing in another, must be allowed to be a desperate measure. In cases which are not growing perhaps gentle direct pressure may

[1] France, 'Guy's Hosp. Reports,' Ser. iii. vol. i. p. 58, 1855.

[2] Guthrie's case, quoted by Nunneley.

[3] Nunneley, 'Med.-Chir. Trans.' vol. xlviii. p. 29.

[4] The whole question of the pathology and treatment of pulsating tumours in the orbit has been elaborately discussed by Mr. Rivington in a paper which will be found in 'Med. Chir. Trans.' vol. lviii.

gradually effect a cure.[1] In some cases, where aneurism affects the end of the subclavian, and the artery rises high in the neck, it may be possible to make compression, either digital or instrumental, on the artery above, as in Mr. Poland's case.[2] If there is gangrene, or a threatening of gangrene, amputation at the shoulder-joint is indicated. The great branches of the subclavian having been removed, the aneurism may cease to grow. 'This operation has been performed four times, by Mr. Spence, Mr. Holden, Mr. H. Smith, and Mr. Heath.[3] All that can be said about it is that in Mr. Spence's case the patient was thought to have been benefited by the operation, but that in none of the others did it do any good. In Mr. Spence's case, however, the limb was threatened with gangrene, and there the operation is no doubt justifiable. In any other circumstances, it seems (to say the best of it) highly dubious' ('Syst. of Surg.').

Ligature of the innominate or first part of the right subclavian.

When the surgeon has made up his mind to risk the ligature of the innominate artery, or of the first part of the right subclavian,[4] his best plan is to obtain free space externally by a V-shaped incision made along the inner margin of the sternomastoid and the upper border of the clavicle. The sternomastoid having been cut away freely from the clavicle, is turned aside, and the sternohyoid and sternothyroid divided. Now the carotid sheath is fairly exposed. If the innominate is to be secured the surgeon follows the carotid down to its bifurcation and passes his finger into the thorax along the artery, which is now the innominate. This manœuvre may be somewhat facilitated by drawing the head strongly backwards. The needle must then be passed around the vessel from without inwards, as low down—i.e. as near the aorta—as can be reached, great care being exercised to avoid puncturing or contusing the right innominate vein. A needle with a sharper curve than ordinary may be employed, or some special contrivance provided with a catch for drawing up the ligature.[5]

If the surgeon intends to tie the first part of the right subclavian, this can only be done just external to the point where the pneumogastric nerve crosses it. On the right side a triangular interspace is left between the carotid artery and the jugular vein, and here the nerve is seen crossing the artery. As the recurrent laryngeal runs inwards round the vessel, and as the phrenic nerve crosses the artery close to its termination, neither of these important nerves will probably be injured; but sympathetic filaments must almost necessarily be interfered with, while the proximity of the large branches of the artery almost necessitates secondary hæmorrhage (of which the great majority of those operated on have died); and the risk of wounding the large veins or the pleura has also to be considered. This operation has never, as yet, been successful.

[1] A case under Mr. Corner's care is related by Mr. Poland (op. infr. cit.) as one of cure by direct pressure; where, however, it seems to me that the recovery was spontaneous. In a case under my own care the patient recovered under direct pressure.

[2] 'Med.-Chir. Trans.' vol. lii. p. 277.

[3] See a paper by Mr. Heath, 'Med.-Chir. Trans.' vol. lxiii. p. 65.

[4] The left subclavian has been tied in its first part behind the apex of the left lung by Dr. J. K. Rodgers of New York, but the operation is so difficult that most surgical writers have spoken of it as impracticable; and it is known that Sir A. Cooper, having attempted it, was obliged to desist, believing that he had injured the thoracic duct. It is hardly worth while to spend time in describing an operation which will probably not be repeated.

[5] The last case of ligature of the innominate artery was under the care of Mr. Thomson of Dublin. It was published in the 'Brit. Med. Journ.' Oct. 14, 1882. The reader will there find a full account of the case and operation and a summary of all the recorded cases. They are 19 in number—16 for aneurism and 3 for secondary hæmorrhage. All proved fatal, except Dr. Smyth's.

Axillary aneurism

Axillary aneurism is a more common affection than subclavian, the free movement of the joint, near which the artery passes, rendering it liable to slight injuries, though in a less degree than the popliteal, which is exposed to injury from a similar cause; so that these aneurisms are frequently found to follow upon sprains and contusions. Total rupture of the axillary artery has been known to be produced by the efforts to reduce a dislocation of the shoulder-joint.[1]

There is usually little or no difficulty in the diagnosis, but the treatment is only too frequently unsuccessful. Three principal measures have to be considered: 1. The ligature of the subclavian artery was long the only resource in this form of aneurism, and it still remains the most easy of application; but it is doubtful whether it is the safest, since the mortality has been very great. 2. Mr. Syme[2] speaks strongly in favour of the old operation; and in cases of rupture of the axillary artery, where no sac has formed, this is no doubt the best course to pursue. The subclavian artery must be commanded by the fingers of an assistant, for which purpose an incision may be made in the usual situation for the ligature of that vessel, and the artery be held firmly against the rib. Then the blood-tumour is to be opened in its whole extent, the clots removed, and both ends of the lacerated vessel tied. The same course may very properly be followed in a traumatic aneurism, particularly if the tumour has so far elevated the clavicle as to make the operation of tying the subclavian difficult and dangerous; but, as I have shown in another place, the relations of the sac to the artery and to the nerves of the plexus are very variable, and the surgeon may easily meet with very great difficulties. 3. Compression has been successfully applied to the third part of the subclavian artery;[3] and though the difficulty of doing this is in some cases so great as to make it wellnigh impossible for the surgeon to do it, or for the patient to endure it, yet in others it will be found quite easy. These differences depend, of course, on the varying height to which the artery rises in the neck, the varying level at which the clavicle is found,[4] and the varying thickness of the neck. In any case in which it seems at all feasible to make compression, and where the rapid growth of the tumour does not contraindicate the attempt, I think the surgeon is bound to try this method of treatment before resorting to the ligature. Coles's compressor, an apparatus constructed for the purpose, or the finger, may be used, according to the depth of the vessel.

Ligature of the subclavian artery

The subclavian artery may be tied in the third part of its course under ordinary circumstances with no great difficulty, though in complicated cases the operations are more embarrassing. The patient's head is to be turned to the opposite side—the affected shoulder is drawn downwards by an assistant as far as possible. The operator draws the skin of the neck down over the chest with the fingers of his left hand, and makes an incision on to the clavicle along its middle third. The skin is then released, and the incision lies about a finger's breadth above the bone. In this way the surgeon avoids all risk of wounding the external jugular vein as it dips under the clavicle. This vein is then divided and drawn aside; or, if there is any difficulty in getting it out of

[1] See Ollivier, in 'St. Bartholomew's Hospital Reports,' vol. ii. p. 96.

[2] [illegible] Press,' vol. xliii. p. 137.

[3] [illegible] Nov. 27, 1873, p. 445.

[4] It may be worth while to notice that some surgeons believe with Mr. Spence that the [illegible] is mainly pushed up passively by the size of the tumour in the axilla, but that [illegible] and perhaps chiefly, an active one, due to irritation of the nerves causing [illegible] to contract and draw the scapula and clavicle upwards.

the way, it is divided between two ligatures. The deep fascia is now opened to the extent of the skin-wound, and the cellular tissue of the subclavian triangle scratched through with the point of the director till the margin of the scalenus anticus muscle is plainly seen. In doing this the omohyoid muscle may be exposed, and possibly the transversalis colli artery may be met with. The surgeon now traces the scalenus anticus muscle down to its insertion into the first rib, and he will then find the artery lying close beneath his finger, emerging from behind the muscle, immediately behind the scalene tubercle. The nervous cord formed by the eighth cervical and first dorsal nerves lies close above and behind the artery, and great care must be taken not to mistake it for the vessel, which may easily be done, if from any cause the pulsation is not plainly perceptible in the artery, or the parts cannot be brought into view. The needle is passed around the vessel either from above or below, as is most convenient, and when this has been done it should be carefully ascertained, first, that only one structure is embraced by the needle, and, secondly, that pressure on that structure commands the pulsation.



Fig. 248. Ligature of the subclavian artery. At the inner angle of the incision the root of the external jugular vein is seen, and its course above is indicated through the skin. Some fibres of the sternomastoid muscle would also probably be seen in this situation. Deeper down is seen the scalenus anticus muscle going into the first rib, and the artery emerging from behind it, with the nerves of the brachial plexus above and behind the vessel. Above these is seen the posterior belly of the omohyoid. The outer angle of the incision reaches to the trapezius muscle.

Sometimes when the aneurism extends too far up the vessel to allow of the third part of the artery being safely tied, the second part has been secured. The operation is essentially the same, only a freer incision is desirable, which is obtained by notching the inner end of the skin-cut upwards, and by dividing the fibres of the sternomastoid as far as may be necessary to bring the scalenus anticus into view. When this has been done the fibres of that muscle are to be divided transversely on a director, with all possible care, to avoid injuring the phrenic nerve, and thus the artery is exposed. The surgeon must remember that on the right side the superior intercostal usually comes off from this part of the artery, so that it is very undesirable to tie the second part of the right artery; but if circumstances have rendered it inevitable he should try and include the branch also in the ligature. The greatest care should be taken not to wound the pleura, which lies close below.

Ligature of the subclavian artery is a very formidable operation, about 45 per cent. of the cases operated on having proved fatal.[1]

[1] 'Of 94 cases where this artery has been tied for aneurism in the axilla 51 have recovered and 43 have died.'—'Lancet,' Sept. 27, 1873, p. 444.

consequence of the long exposure of the protruded eyeball;[1] and this is in itself a strong presumption against the presence in such instances of arterial aneurism, and a strong argument against the too early resort to any serious surgical operation.

The appearances on dissection have also been very various. In some cases it is said that an ordinary encysted aneurism of the ophthalmic artery has been found,[2] whether in the orbit or in the sella turcica.[3] In other cases, as in those reported by Dr. Delens from Nélaton's practice (op. supr. cit.) there has been a communication between the internal carotid and the venous channel of the cavernous sinus (arteriovenous aneurism), and in these the pulsating tumour over the eyeball has been proved to have been formed by a dilated and pulsating vein; in others, again, nothing beyond a collection of bloodclot (thrombosis) in the sinus pressing on the artery (as in Bowman's case).

For these reasons surgeons are now less quick than they used to be to resort to the ligature of the carotid artery in such cases. It is better at first to watch the case; and if no great inconvenience is caused by the disease it is very doubtful whether any treatment is necessary; otherwise digital pressure on the carotid artery as long and as frequently as the patient can tolerate it, is advisable. If, in spite of this, the symptoms are advancing, the choice lies between injection of perchloride of iron and ligature of the carotid.[4]

Subclavian aneurism.

Subclavian aneurism is a very formidable and fatal disease; like all other aneurisms near the heart, it is usually fatal if left to itself, while surgical treatment generally only hastens death. The only really successful methods of treatment in aneurism are those in which the surgeon deals, not with the blood or the contents of the sac only, but also with the sac itself and the tissues which surround it: by taking away the eccentric pressure of the blood on the walls of the sac, the latter are allowed to react on the contained blood, and this is a powerful aid in the cure of the disease. On the other hand, a softened, inflamed or ruptured sac is usually the precursor of death when the tumour is near the heart. Now, in aneurism of the first or second part of the subclavian artery the ligature can only be applied to the innominate artery, and in aneurism of the third part of the right subclavian to the first part of the same vessel; and both operations have proved uniformly fatal, except in one case, in which the innominate and subsequently the vertebral artery were tied by Dr. Smyth of New Orleans, and the patient survived after several severe attacks of secondary hæmorrhage. Galvano-puncture may be tried, but its effect is so commonly to set up inflammation of the sac that it must always be doubtful whether it is not more dangerous than abandoning the case to nature. The 'manipulation' of the tumour remains as the only active surgical measure; and this, though perfectly justifiable, and indeed indicated, when the sac contains a good deal of clot in one part, but is growing in another, must be allowed to be a desperate measure. In cases which are not growing perhaps gentle direct pressure may

[1] France, 'Guy's Hosp. Reports,' Ser. iii. vol. i. p. 58, 1855.

[2] Guthrie's case, quoted by Nunneley.

[3] Nunneley, 'Med.-Chir. Trans.' vol. xlviii. p. 29.

[4] The whole question of the pathology and treatment of pulsating tumours in the orbit has been elaborately discussed by Mr. Rivington in a paper which will be found in 'Med. Chir. Trans.' vol. lviii.

Far more commonly the artery is tied just above the wrist, between the tendon of the flexor carpi ulnaris and the ulnar tendon of the flexor sublimis digitorum. It is covered here, not only by the common deep fascia, but also by a special and strong though thin aponeurosis. This having been divided, the artery will be found between its veins, and with the nerve on the inner side.

Ligature of the radial.

Similarly the radial may be tied in the upper third of its course, but this is rarely necessary. It involves, however, no division of the muscles. An incision being made along the belly of the supinator longus, the artery and venæ comites come into view between that muscle and the pronator teres. The nerve is not here in contact with the vessels.

The common situation, however, for the ligature of the radial also is just above the wrist, where it may easily be found by dividing the deep fascia along the inner border of the flexor carpi radialis between that tendon and

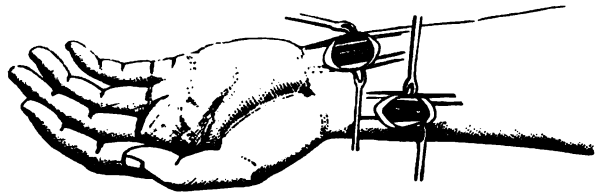


Fig. 261. Ligature of the ulnar and radial arteries. The upper figure illustrates the ligature of the ulnar. The upper double hook draws aside the tissues, exposing the tendon of the Fl. carpi ulnaris. The lower exposes the ulnar tendon of the Fl. subl. digitorum. The artery is seen with its nerve on the ulnar side, and the venæ comites on either side of it.
The lower figure illustrates the ligature of the radial. The lower double hook exposes the tendon of the supinator longus, the upper that of the Fl. carpi radialis. Between them is seen the artery, having its venæ comites on the two sides. *Mem.*—In practice there is no necessity for exposing the tendons in this way.

the supinator longus. When the fascia is freely divided the artery and its veins come into view. Here also the nerve is not in contact with the vessels.

Abdominal aneurism.

Abdominal aneurism affects either the abdominal aorta or one of the smaller arteries. Its diagnosis is not always easy. In the first place, the abdominal aorta itself sometimes pulsates so powerfully as to simulate aneurism, when no aneurism exists. This is most common in young women, and is sometimes called 'hysterical pulsation,' but is also not unusual in nervous men of relaxed fibre. It may be known from aneurism by the absence of any true aneurismal bruit (though some sound can often be elicited by pressure with the stethoscope, and sometimes in the vein as well as the artery), by the fact that the pulsation can be stopped by firm pressure with a single finger, if the patient can tolerate it; and above all, by watching the case, when it will be seen to remain in the same condition for an indefinite period. Again, cancer connected with the bones of the spine or pelvis, and sometimes cancer of the lumbar glands or even of the kidney, may pulsate, and thus simulate aneurism—as to which the reader must be referred to what has been said above (page 533).[1] And, on the other hand, abdominal aneurisms sometimes do not pulsate, and then their diagnosis becomes exceedingly obscure.

When the diagnosis of aneurism is established it is not always easy to specify the artery affected; but this is perhaps of minor importance. Aneurism of the abdominal aorta produces pain in the back from pressure on the spine, weakness and pain in motion from the same cause, loss of nutrition,

[1] Also to a paper in 'St George's Hospital Reports,' vol. vii. p. 173.

Axillary aneurism.

Axillary aneurism is a more common affection than subclavian, the free movement of the joint, near which the artery passes, rendering it liable to slight injuries, though in a less degree than the popliteal, which is exposed to injury from a similar cause; so that these aneurisms are frequently found to follow upon sprains and contusions. Total rupture of the axillary artery has been known to be produced by the efforts to reduce a dislocation of the shoulder-joint.[1]

There is usually little or no difficulty in the diagnosis, but the treatment is only too frequently unsuccessful. Three principal measures have to be considered: 1, The ligature of the subclavian artery was long the only resource in this form of aneurism, and it still remains the most easy of application; but it is doubtful whether it is the safest, since the mortality has been very great. 2. Mr. Syme[2] speaks strongly in favour of the old operation; and in cases of rupture of the axillary artery, where no sac has formed, this is no doubt the best course to pursue. The subclavian artery must be commanded by the fingers of an assistant, for which purpose an incision may be made in the usual situation for the ligature of that vessel, and the artery be held firmly against the rib. Then the blood-tumour is to be opened in its whole extent, the clots removed, and both ends of the lacerated vessel tied. The same course may very properly be followed in a traumatic aneurism, particularly if the tumour has so far elevated the clavicle as to make the operation of tying the subclavian difficult and dangerous; but, as I have shown in another place, the relations of the sac to the artery and to the nerves of the plexus are very variable, and the surgeon may easily meet with very great difficulties. 3. Compression has been successfully applied to the third part of the subclavian artery;[3] and though the difficulty of doing this is in some cases so great as to make it wellnigh impossible for the surgeon to do it, or for the patient to endure it, yet in others it will be found quite easy. These differences depend, of course, on the varying height to which the artery rises in the neck, the varying level at which the clavicle is found,[4] and the varying thickness of the neck. In any case in which it seems at all feasible to make compression, and where the rapid growth of the tumour does not contra-indicate the attempt, I think the surgeon is bound to try this method of treatment before resorting to the ligature. Coles's compressor, an apparatus constructed for the purpose, or the finger, may be used, according to the depth of the vessel.

Ligature of the subclavian artery.

The subclavian artery may be tied in the third part of its course under ordinary circumstances with no great difficulty, though in complicated cases few operations are more embarrassing. The patient's head is to be turned to the opposite side—the affected shoulder is drawn downwards by an assistant as far as possible. The operator draws the skin of the neck down over the chest with the fingers of his left hand, and makes an incision on to the clavicle along its middle third. The skin is then released, and the incision lies about a finger's breadth above the bone. In this way the surgeon avoids all risk of wounding the external jugular vein as it dips under the clavicle. This vein is next defined and drawn aside; or, if there is any difficulty in getting it out of

[1] See Callender, in 'St. Bartholomew's Hospital Reports,' vol. ii. p. 96.

[2] 'Med.-Chir. Trans.' vol. xliii. p. 137.

[3] 'Lancet,' Sept. 27, 1873, p. 445.

[4] It may be worth while to notice that some surgeons believe with Mr. Spence that the clavicle is not merely pushed up passively by the size of the tumour in the axilla, but that its elevation is also, and perhaps chiefly, an active one, due to irritation of the nerves causing the muscles to contract and draw the scapula and clavicle upwards.

Ligature of the abdominal aorta and of the iliac arteries.

Whether the abdominal aorta should ever again be tied is a matter of opinion. My own is that, as the operation has been practised at least eight times, and never with success, the patient has a better prospect from rest and medical treatment; but the operation on the common iliac is undoubtedly justifiable. There are two different ways of performing it. In one of these —Sir P. Crampton's method[1]—the artery is sought from behind by an incision made 'from the end of the last rib obliquely forwards and downwards to the crista ilii, and then curved forwards above and parallel to the crest of the ilium, terminating at the anterior superio spine. The muscles and fascia transversalis were cut through at the bottom of the incision til the subperitoneal interval was reached, and then—the peritoneum being held back by the front of the finger—a probe-pointed bistoury was run along the back of the finger, and so, by repeated strokes of the bistoury, the muscles were divided to the extent of the external wound. Sufficient room was obtained to pass in the whole hand and raise the peritoneum and intestines from the fascia iliaca. The parts were then plainly visible, and the vessel easily secured.'

The other method of securing the common iliac artery is from the front, and this operation is essentialy the same, whether the operator wishes to secure the aorta, the common, the internal, or the upper part of the external iliac artery. An incision is made through the abdominal parietes, the extent of which varies according to the height which the operator wishes to attain. It commences below, just external to the internal abdominal ring, runs outwards somewhat parallel to Poupart's ligament, and then curves inwards towards the umbilicus. If the common iliac or the aorta is to be tied the incision should not be less than six inches in length. The three abdominal muscles having been divided, and the fascia transversalis incised along the whole extent of the wound, the peritoneum, containing the intestines, is to be gently separated from the abdominal wall until the iliac vessels are found. They must then be traced upwards as far as necessary, their relations being attentively borne in mind. If the aorta is to be secured, the main point is to separate it from the cellular tissue which forms its sheath, and from the vena cava, without any injury to the latter or to the parts in front, in which the great lymphatic vessels and the commencement of the receptaculum chyli might be wounded. The right common iliac artery is in relation with three veins—the vena cava lies on the right side of its upper part, the right common iliac vein on its right side below, and the left common iliac crosses behind it to join its fellow of the opposite side. The left common iliac vein lies behind and internal to its artery. The ureter crosses over the bifurcation of the common iliac, or the upper part of the external iliac artery, and the spermatic vessels pursue their course upwards in front of the external iliac artery; but both these structures are generally so adherent to the peritoneum that in raising that membrane the surgeon pushes them away from the artery. The external iliac vein lies on the inner side of the artery, inclining on the left side more to its deep surface, and in tying the external iliac the genitocrural nerve, which runs down on its surface, should be looked for and avoided. In tying the lower end of the external iliac artery less extensive incisions are required. Mr. Abernethy, in his original operation (the first in which this artery was tied),[2] made the incision upwards and inwards from the centre of Poupart's

[1] 'Med.-Chir. Trans.' vol. xvi. p. 102.

[2] See a lecture in the 'Lancet,' Aug. 29, 1874, for a summary account of the early operations on this artery.

Aneurism below the axilla.

Spontaneous aneurisms below the axilla are extremely rare, though they are not unknown even in arteries so small as those of the hand; but I do not think it would answer any good purpose to speak in detail here of such rare cases. The main point to remember is, that spontaneous aneurism of these small vessels is very commonly associated with disease of the heart or general arterial degeneration, and ought not to be too actively treated.

The arteries of the upper extremity are, however, usually tied for wound, either at the part wounded, or, in the case of wounds of the palm, at a higher spot.

Ligature of the axillary.

The axillary is very rarely tied in the present day as a formal operation. In the dissecting-room it may be reached in any part of its course either by a free division of the pectoralis major (the precise line for which matters little, but which is generally effected by an incision convex inwards from the coracoid process to the edge of the anterior flap of the axilla), or the first part of the artery may be exposed by cutting asunder the clavicular and sternal portions of the pectoralis major and drawing them away from each other with strong double hooks, without dividing any muscular fibres. In the living subject, however, it would be much better to follow Guthrie's advice, by cutting freely through the anterior flap of the axilla and tracing the artery upwards to the point where the ligature is to be applied. The vein lies to the front and inner side of the artery, and the varying position of the median nerve must be recollected.

Ligature of the brachial.

The brachial is generally tied about its centre by an incision along the edge of the biceps, or, if that edge cannot be seen, in a line drawn from the middle point between the flaps of the axilla above to the middle of the bend of the elbow below. Possibly the basilic vein or the internal cutaneous nerve or even the ulnar nerve may be seen in the first incision, and if so, should be avoided. The deep fascia being opened the edge of the biceps will be exposed, and if the muscle is large is to be drawn aside. Then the median nerve generally comes into view,[1] and must be gently displaced, and the artery picked up between its venæ comites. When the nerve crosses behind the artery the vessels will, of course, come into view at once.

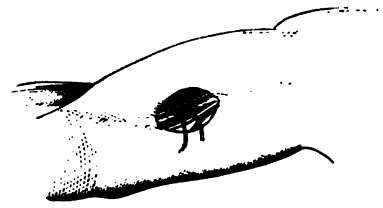


FIG. 260. Ligature of the brachial artery. The edge of the biceps is seen. The median nerve is shown in front of the artery. There are venæ comites on either side which are not shown. At the inner side and behind are seen the basilic vein and internal cutaneous nerve, but these structures are not generally exposed in the operation.

Ligature of the ulnar.

The ulnar may be tied at the upper part of the forearm, but this is very rarely necessary. Here it lies under the mass of muscles which arise from the inner condyle (except the flexor carpi ulnaris), and is crossed by the median nerve. The line of the vessel is from the middle of the bend of the elbow to the outer side of the pisiform bone. There are two ways of exposing it—either from above or below. In the former, an incision having been made over the course of the artery, the bicipital fascia is freely divided—the median nerve sought, the pronator teres freely cut through, and the vessel found below it. In the latter the ulnar nerve is sought under the radial border of the flexor carpi ulnaris and traced till it is found joining its artery, which is then followed upwards, the muscles being successively divided till the point is reached where it is to be tied.

[1] This nerve crosses behind the artery about once in every four cases.

Far more commonly the artery is tied just above the wrist, between the tendon of the flexor carpi ulnaris and the ulnar tendon of the flexor sublimis digitorum. It is covered here, not only by the common deep fascia, but also by a special and strong though thin aponeurosis. This having been divided, the artery will be found between its veins, and with the nerve on the inner side.

Ligature of the radial.

Similarly the radial may be tied in the upper third of its course, but this is rarely necessary. It involves, however, no division of the muscles. An incision being made along the belly of the supinator longus, the artery and venæ comites come into view between that muscle and the pronator teres. The nerve is not here in contact with the vessels.

The common situation, however, for the ligature of the radial also is just above the wrist, where it may easily be found by dividing the deep fascia along the inner border of the flexor carpi radialis between that tendon and

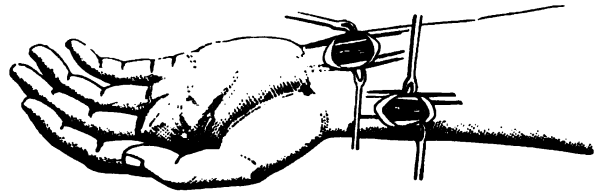


FIG. 261. Ligature of the ulnar and radial arteries. The upper figure illustrates the ligature of the ulnar. The upper double hook draws aside the tissues, exposing the tendon of the Fl. carpi ulnaris. The lower exposes the ulnar tendon of the Fl. subl. digitorum. The artery is seen with its nerve on the ulnar side, and the venæ comites on either side of it.
The lower figure illustrates the ligature of the radial. The lower double hook exposes the tendon of the supinator longus, the upper that of the Fl. carpi radialis. Between them is seen the artery, having its venæ comites on the two sides. *Mem.*—In practice there is no necessity for exposing the tendons in this way.

the supinator longus. When the fascia is freely divided the artery and its veins come into view. Here also the nerve is not in contact with the vessels.

Abdominal aneurism.

Abdominal aneurism affects either the abdominal aorta or one of the smaller arteries. Its diagnosis is not always easy. In the first place, the abdominal aorta itself sometimes pulsates so powerfully as to simulate aneurism, when no aneurism exists. This is most common in young women, and is sometimes called 'hysterical pulsation,' but is also not unusual in nervous men of relaxed fibre. It may be known from aneurism by the absence of any true aneurismal bruit (though some sound can often be elicited by pressure with the stethoscope, and sometimes in the vein as well as the artery), by the fact that the pulsation can be stopped by firm pressure with a single finger, if the patient can tolerate it; and above all, by watching the case, when it will be seen to remain in the same condition for an indefinite period. Again, cancer connected with the bones of the spine or pelvis, and sometimes cancer of the lumbar glands or even of the kidney, may pulsate, and thus simulate aneurism—as to which the reader must be referred to what has been said above (page 588).[1] And, on the other hand, abdominal aneurisms sometimes do not pulsate, and then their diagnosis becomes exceedingly obscure.

When the diagnosis of aneurism is established it is not always easy to specify the artery affected; but this is perhaps of minor importance. Aneurism of the abdominal aorta produces pain in the back from pressure on the spine, weakness and pain in motion from the same cause, loss of nutrition,

[1] Also to a paper in 'St George's Hospital Reports,' vol. vii. p. 173.

possibly from pressure on the thoracic duct or some of the lacteals, and vomiting or other disturbance of digestion from pressure on the stomach, intestines, or liver. It threatens death by rupture into the peritoneal cavity or into the cellular tissue. Aneurisms of the branches of the aorta (cœliac axis, superior mesenteric, &c.) produce much the same symptoms, and are distinguished from the aortic aneurisms chiefly by their position, and those of the superior mesenteric by their mobility, which is sometimes very great, as well as by the way in which the bruit can sometimes be traced upwards into the aorta.[1] Aneurism of the common iliac is rare, but when it occurs it can generally be known by its situation, and by the definite limitation of the symptoms to one side of the body. When the external iliac artery is affected there is not usually any difficulty in determining the fact, though it may not be easy to decide how high the tumour extends.

The treatment of aneurism of the abdominal aorta must as a general rule be restricted to rest and medical measures only; but some of the aneurisms which affect the lowest part of the vessel may be under the influence of pressure applied to the artery as it lies on the spine just above the origin of the inferior mesenteric. Some surgeons believe in the possibility of compressing even a higher part of the artery than this, where it lies between the pillars of the diaphragm. This bold attempt was first made, and with success, by Dr. Murray of Newcastle, in the year 1864.[2] His patient was cured temporarily, but a higher part of the aorta became aneurismal, and he died six years after. Post-mortem examination proved that the aneurism had really affected the lowest part of the aorta itself. Several other abdominal aneurisms have been cured by pressure under chloroform, and in some of them the aorta is believed to have been the artery affected, though in no other, as far as I know, has definite anatomical proof of the fact been obtained. And the operation is now a recognised surgical proceeding very far superior to the ligature of the aorta (which has proved uniformly fatal), or even to that of the common iliac, from which only one-fourth of the patients have recovered. It has, however, its own dangers, and they are by no means small. These dangers arise from the protracted anæsthesia, and from the risk of contusing the viscera (the intestines, the mesentery, the pancreas, and the kidney have all been found to have been injured), or of embarrassing the action of the heart, or injuring the great sympathetic ganglia and nerves. Several deaths have occurred from these causes, and in several cases the compression has failed to effect a cure; but it is a most valuable remedy, and has often also been used in the treatment of aneurism of the external iliac, the common iliac being then usually selected for pressure. The patient's bowels ought to be well unloaded, and the parietes of the belly relaxed by bending the body. He should be placed fully under the anæsthetic, and the tourniquet should then be screwed down. If the aorta is to be compressed, the pulsation in the aneurism and in both femorals must be completely abolished; if the common or external iliac, one femoral only. It is well to maintain the temperature of the limbs by swathing in wool. Some surgeons apply distal pressure also below the aneurism, but its benefit is doubtful. The pulse and respiration should be carefully observed by the chloroformist, while the surgeon and his assistants manipulate the tourniquet and attend to the pulsation. The anæsthesia need not be at all deep, and has been continued for many hours in some cases without serious danger.

[1] See a case under Mr. Pollock's care, reported in the 'Clin. Soc. Trans.' vol. vii. p. 58.

[2] 'Med.-Chir. Trans.' vol. xlvii. p. 187. See also 'Lancet,' Feb. 8. 1873.

Ligature of the abdominal aorta and of the iliac arteries.

Whether the abdominal aorta should ever again be tied is a matter of opinion. My own is that, as the operation has been practised at least eight times, and never with success, the patient has a better prospect from rest and medical treatment; but the operation on the common iliac is undoubtedly justifiable. There are two different ways of performing it. In one of these —Sir P. Crampton's method[1]—the artery is sought from behind by an incision made 'from the end of the last rib obliquely forwards and downwards to the crista ilii, and then curved forwards above and parallel to the crest of the ilium, terminating at the anterior superio spine. The muscles and fascia transversalis were cut through at the bottom of the incision til the subperitoneal interval was reached, and then—the peritoneum being held back by the front of the finger—a probe-pointed bistoury was run along the back of the finger, and so, by repeated strokes of the bistoury, the muscles were divided to the extent of the external wound. Sufficient room was obtained to pass in the whole hand and raise the peritoneum and intestines from the fascia iliaca. The parts were then plainly visible, and the vessel easily secured.'

The other method of securing the common iliac artery is from the front, and this operation is essentialy the same, whether the operator wishes to secure the aorta, the common, the internal, or the upper part of the external iliac artery. An incision is made through the abdominal parietes, the extent of which varies according to the height which the operator wishes to attain. It commences below, just external to the internal abdominal ring, runs outwards somewhat parallel to Poupart's ligament, and then curves inwards towards the umbilicus. If the common iliac or the aorta is to be tied the incision should not be less than six inches in length. The three abdominal muscles having been divided, and the fascia transversalis incised along the whole extent of the wound, the peritoneum, containing the intestines, is to be gently separated from the abdominal wall until the iliac vessels are found. They must then be traced upwards as far as necessary, their relations being attentively borne in mind. If the aorta is to be secured, the main point is to separate it from the cellular tissue which forms its sheath, and from the vena cava, without any injury to the latter or to the parts in front, in which the great lymphatic vessels and the commencement of the receptaculum chyli might be wounded. The right common iliac artery is in relation with three veins—the vena cava lies on the right side of its upper part, the right common iliac vein on its right side below, and the left common iliac crosses behind it to join its fellow of the opposite side. The left common iliac vein lies behind and internal to its artery. The ureter crosses over the bifurcation of the common iliac, or the upper part of the external iliac artery, and the spermatic vessels pursue their course upwards in front of the external iliac artery; but both these structures are generally so adherent to the peritoneum that in raising that membrane the surgeon pushes them away from the artery. The external iliac vein lies on the inner side of the artery, inclining on the left side more to its deep surface, and in tying the external iliac the genitocrural nerve, which runs down on its surface, should be looked for and avoided. In tying the lower end of the external iliac artery less extensive incisions are required. Mr. Abernethy, in his original operation (the first in which this artery was tied),[2] made the incision upwards and inwards from the centre of Poupart's

[1] 'Med.-Chir. Trans.' vol. xvi. p. 102.

[2] See a lecture in the 'Lancet,' Aug. 29, 1874, for a summary account of the early operations on this artery.

ligament along the course of the artery. But this operation has now fallen out of use. The objection to it is that it gives little room, and is not available, if the operator finds it necessary to go higher than he at first intended. The lower part of the external iliac artery can, however, be easily reached by an incision parallel to and a little above the outer half of Poupart's ligament, by just pushing up the lower part of the peritoneum, and this is the plan now in common use. If more room is required it can be easily got by extending the outer end of the incision upwards and inwards. The peritoneum and intestines having been gently pressed to the other side till the finger is about to pass into the true pelvis, the artery will be met with lying on the brim of that cavity. It must be carefully separated from its vein, and the ligature passed from within outwards, care being taken not to include the genitocrural nerve.

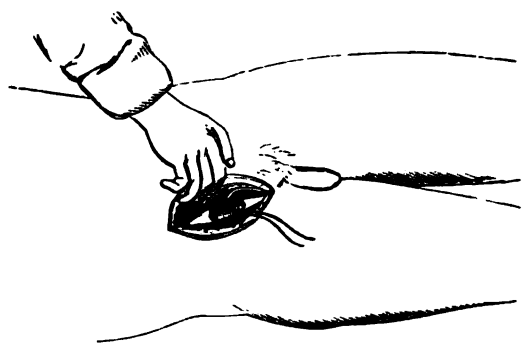


FIG. 262. Ligature of the external iliac artery. The assistant's hand is shown, pushing back the intestines, covered with peritoneum. The two ends of the ligature are seen passing in between the artery, which is external, and the vein on the inner side, a large part of the sheath having been cut away to show the vessels. Towards the internal ring will be seen the white end of the vas deferens dipping into the pelvis, and the spermatic vessels lying on the peritoneum.

The internal iliac is found either by tracing the common iliac downwards, or the external upwards, till the bifurcation is reached, and then passing the finger down the artery into the pelvis, and scratching it clean with the finger-nail and director, so as to get the ligature round it about an inch from its origin if possible. The great depth of the vessel renders a very free incision necessary, and there is often much difficulty in getting the ligature round the artery, though Mr. Syme's case shows that this may be done with the ordinary aneurism-needle.[1]

Gluteal aneurism.

Gluteal aneurism is a rare disease, and one with which, therefore, no surgeon is sufficiently familiar to speak with much decision as to its treatment. It is very commonly traumatic, either from direct perforation of the artery by a stab or from an injury in which the vessel is contused against the bone. The artery affected may be either the gluteal or sciatic, or even the internal pudic, as it crosses the spine of the ischium, as in a preparation of John Hunter's in the College of Surgeons' Museum. In wounds the smaller arteries, branches of the gluteal or sciatic, may be implicated. The symptoms are not always obvious. In traumatic aneurism (so called) there may have been no sac, or in this, as well as in spontaneous aneurism, the sac may have given way, and so there may be no pulsation;[2] and many such tumours have been opened by mistake for abscess, usually with a fatal result. Such a disaster would probably be avoided by auscultation, for it is certain that in many, if not all, such cases a bruit would be audible.

[1] Syme, 'Observations in Clinical Surgery,' p. 168.

[2] The student must always remember that the pulsation of an aneurism depends on the reaction of the sac upon the blood which distends it, so that a free rupture of the sac involves loss of pulsation.

Gluteal aneurism is not necessarily fatal. Indubitable cases of spontaneous cure are recorded, and in other cases the disease has long remained stationary. But when the pressure of the tumour on the nerves causes much distress, or when the size of the aneurism is increasing, and it threatens soon to burst, surgical treatment is necessary; but it is not easy in the present state of our knowledge to say what is on the whole the most promising method of treatment. In recent wounds, and in those cases of traumatic aneurism which most nearly approach to the character of recent wounds, the best plan is to lay the sac freely open and tie the artery. Hæmorrhage may be controlled during this operation either by plugging the sac with the fingers on Mr. Syme's plan or by pressure on the aorta by Lister's tourniquet, or by compression made from the rectum.[1] Many cases, I have no doubt, might be cured by compression of the aorta or common iliac under chloroform. Dr. Sands has published in the 'Am. Journ. Med. Sci.' April 1881, a very interesting case in which prolonged digital compression of the internal iliac artery from the rectum was made, but without success in curing the aneurism, though the circulation was completely controlled. Some cases have been treated successfully with coagulating injections,[2] and galvanopuncture may very fairly be tried in these cases, or manipulation. In cases where the opening in the artery is situated inside the pelvis—a fact which can often be ascertained by examination from the rectum, and which is extremely probable in spontaneous aneurism—the surgeon will probably think it better, on the failure of compression, to resort to the ligature of the internal iliac artery, an operation, however, which is so very dangerous from its anatomical difficulties, as well as from the risk of finding the artery diseased, that it should be avoided as much as possible.

For many details on the diagnosis and treatment of gluteal aneurism, for which my present work affords no space, I would refer to a lecture published in the 'Lancet,' July 11, 1874.

Femoral aneurism.

Aneurism of the femoral artery is met with either in the groin, affecting the common femoral (inguinal aneurism), or in the lower part of Scarpa's triangle, affecting the superficial femoral, and often spreading down into the popliteal space—femoro-popliteal aneurism—or in some intermediate situation; and here the common or the superficial femoral may be implicated, according to the level at which the profunda arises, which in the living subject can hardly be determined,[3] or the profunda itself,[4] or even one of the secondary branches, as the external circumflex,[5] may be the seat of the aneurism.

As a rule, aneurisms in the thigh, when they occur in a tolerably healthy subject, and the sac is perfect, are best treated by pressure on the femoral

[1] A very interesting and successful case of ligature of the gluteal for traumatic aneurism by laying open the sac, under the care of Dr. Thorndike of Boston, U.S., will be found in the 2nd series of the 'Med. and Surg. Rep.' of the Boston City Hospital, p. 219.

[2] Compression of the aorta would, of course, be employed during the injection of the coagulating fluid.

[3] I would refer to a case described by Sir Prescott Hewett ('Med.-Chir. Trans.' vol. xxix. p. 75), under Sir B. Brodie's care, in which the external iliac was tied, and which is figured on p. 539. Before dissection this was believed to be an aneurism of the common femoral. After death it was found that the profunda came off rather high, and that the aneurism really sprang from the commencement of the superficial femoral.

[4] Several instances of aneurism of the profunda may be found quoted in a lecture published in the 'Lancet,' Oct. 17, 1874, under the care of Erichsen, Cock, and P. H. Watson.

[5] An aneurism occurring spontaneously in the external circumflex artery is recorded by M. Letenneur of Nantes in the 'Bulletin de la Soc. de Chir.' 1856.

in the groin. This pressure is, I think, equally indicated in aneurism of the common and superficial femoral, or in the rare cases where the profunda or other smaller branches are affected. For although in aneurism situated low down in the thigh it might on other grounds seem desirable to put pressure on the superficial or on the lower part of the common femoral, yet these arteries are so much more deeply placed, and their compression is so much more painful, that in practice it is found much easier to cure the disease by pressure in the groin. Digital pressure is, I have no doubt, far superior to any other form in this situation, though the artery is so easily compressed that any other form of pressure can be used; and cases have been treated successfully by the pressure of a weight, suspended from a frame or cradle, or by various forms of tourniquet.

In iliofemoral aneurism it may be necessary to make instrumental pressure under chloroform on the aorta or common iliac, as above described; and in some cases of aneurism which are either entirely femoral or only affect the very end of the external iliac artery, the latter vessel might be compressed, though, as a general rule, it would be more prudent to select the higher artery, so as to avoid all risk of compressing the aneurismal tumour, which might easily occasion inflammation and rupture of the sac.

For cases of iliofemoral aneurism cured by rapid compression under chloroform, see 'Lancet,' Oct. 10, 1874.

When pressure has failed the resort to the ligature should not in my opinion be long delayed. If the common femoral be affected the external iliac artery must be tied, and in iliofemoral aneurism the surgeon may even find himself obliged to operate on the common iliac. In a case under the care of Dr. G. Buchanan of Glasgow ('Brit. Med. Journ.' Dec. 4, 1880) that surgeon was so impressed by recurrence of pulsation after simple ligature of the external iliac (as happened in Sir B. Brodie's case figured on p. 539), that he tied also the superficial femoral and the profunda below the aneurism, and laid open the sac—in fact performed the old operation.

Ligature of the common femoral.

In aneurism implicating the lower part of the common or the superficial femoral or profunda arteries, the question has arisen whether the common femoral artery might not be secured. The general rule has been that if the aneurism extends too high up to enable the surgeon to secure the superficial femoral artery the external iliac should be tied, since it was taught that the ligature of the common femoral in the groin, though a very easy was a peculiarly fatal operation—so much so that some good surgeons have gone so far as to say that the operation ought to be banished from practice.[1] But I cannot discover on what data this opinion is founded. The Irish surgeons, following on the example of the elder Porter, have practised this operation tolerably often, and their experience of it has been pretty satisfactory,[2] and Dr. Mott also highly recommends it, and says he has often performed it with success.[3] My own impression is that the operation is less dangerous than the ligature of the external iliac artery, though much more so than that of

[1] Erichsen, 'Sc. and Art of Surg.' 5th ed. vol. ii. p. 110. Mr. Erichsen, however, in his later editions, though he does not approve of the operation, speaks of it in terms of much less sweeping condemnation.

[2] Out of nine cases three died—one from hæmorrhage previous to operation (this case should be omitted from the list), one with diseased arteries from secondary hæmorrhage, and another in whom there was a high bifurcation and the ligature was placed close below the profunda, also of secondary hæmorrhage. The last is the only case which can really be said to have died in consequence of the kind of operation selected.

[3] See also other cases quoted in the 'Lancet' for Aug. 29, 1874.

Ligature of the superficial femoral artery.

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triangle. A much freer incision must be made in the line above indicated from the apex of Scarpa's triangle downwards. The sartorius muscle having been exposed, and recognised by the direction in which its fibres run, its upper edge must be drawn downwards or incised, if the operator wishes to reach the artery in the upper part of the canal; or contrariwise, the muscle must be drawn upwards, if the vessel is to be secured near the opening in the adductor magnus. Then, the anterior wall of the canal having been laid open, the artery is sought with the long saphenous nerve lying usually in front of it and within the sheath. This should be carefully avoided, as well as the vein.

Popliteal aneurism.

Popliteal aneurism is the form by far the most familiar to surgeons; and it is satisfactory to know that the treatment of this disease—a disease so formidable in the times before Hunter that Mr. Pott expressed, in the most decided terms, his preference for amputation over the treatment then in vogue—has now become so successful that out of 212 cases admitted into various metropolitan and provincial hospitals, chiefly during the ten years 1861–70, and reported to me from those hospitals, 166 were cured entirely and permanently by ligature or pressure (and a few by less common means), 12 were cured after amputation, in four the disease was not cured, and 29 died.[1] This is a list formed entirely of unselected and common cases just as they presented themselves at the various hospitals, containing, of course, a percentage of complicated and advanced cases which were, probably, in themselves incurable. The cases were under the care of surgeons of very various degrees of experience and operative skill. In fact, it seems to me to represent in all ways the average of success and failure which the surgeons of the present day have met with in the treatment of popliteal aneurism. And this average of success, large as it is, will, there is no doubt, be largely increased by the improved methods of compression recently introduced, and by the increasing intelligence of the labouring population, and their diminished fear of surgical treatment, leading them to apply earlier for advice.

Again, I think that I have shown (in the lectures above referred to) that the mortality after the Hunterian operation on the femoral artery has been greatly diminished, as has also been the prevalence of gangrene, secondary hæmorrhage, and other untoward but not necessarily fatal complications, in modern practice, in all probability as a consequence of the more careful method of operating, and simpler treatment after operation, which distinguish modern surgery; so that the mortality which in 188 published cases tabulated by Norris[2] was 24·46 per cent., was only 14·94 per cent. in 87 similar[3] (published and unpublished) cases contained in the list above referred to. These facts, which I think can hardly be gainsaid, are most encouraging to a surgeon in undertaking the care of a case of popliteal aneurism. There remains the question, what class of cases are adapted for the ligature, what for compression, and what for flexion? And after compression or flexion has been attempted, how long should the attempt be persisted in, if not at once successful?

I may, perhaps, add that, though cases are on record in which cure has been obtained by some of the less usual proceedings—such as manipulation, coagulating injections, Esmarch's bandage, &c., it seems to me, speaking

[1] 'Lancet,' May 1, 1875.

[2] See Norris's 'Contributions to Surgery.'

[3] By similar cases I mean cases in which the femoral artery was tied, as in those tabulated by Norris, without the previous use of compression.

generally, that such proceedings are so far more dangerous and so far less likely to succeed than the known and familiar resources of surgery, ligature and pressure, that I think it useless to spend time on their discussion here.[1]

In discussing the treatment of popliteal aneurism it is well to study the symptoms and the anatomy of various specimens of it. The first thing that strikes us is the difference in the relation of the sac to the artery. Some aneurisms grow from the anterior face of the vessel towards the knee-joint. These are marked by a distinct line of pulsation in the course of the artery lying over and distinguished from the general pulsation of the tumour, and by the readiness with which the joint becomes inflamed. The more common form (as it seems) grows from the back, or partly from the side, of the artery, and is marked by the absence of any such distinct line of pulsation, and by the early implication of the nerve, leading to pain shooting down the limb, and, by pressure on the vein, causing œdema and weight of the leg and foot.

My own impression is that aneurisms on the anterior face of the artery are rarely cured by any measure short of the ligature; and even the latter often fails and amputation becomes necessary.[2]

Again, the progress of the case has a most important influence on the treatment to be adopted. In an aneurism which is extending rapidly, and of which the sac is, therefore, thin and probably imperfect in parts, it seems more prudent to resort to the ligature at once; and generally in all the severer cases, and in those where the tumour has already burst, but where the surgeon does not think it necessary to amputate at once, the ligature is probably the safest course.[3]

Genu-flexion.

Flexion is indicated in small aneurisms, situated on the posterior or lateral aspect of the artery, in which the pulsation and bruit are suspended by bending the knee. It need not be extreme nor painful, nor need the limb be bandaged or confined in any way, at least in many cases. Voluntary flexion, in which the patient is allowed to change the position of the limb slightly, will succeed in many cases, and will be tolerated where forced flexion would produce pain and would be given up. Besides, forced flexion has been known to produce rupture of the sac, which voluntary flexion hardly could do. Flexion seems to act partly by retarding the blood-stream, partly by direct pressure, and probably also by displacement of clot. It may easily be combined with digital or instrumental pressure.

When pressure or flexion, either alone or in combination, are to succeed, a perceptible amelioration of the symptoms is generally noticed at once, i.e. in the course of the first two or three days. If this is not the case it becomes a very important question how long the attempt should be continued, Relying on the doctrine that if pressure failed to cure the aneurism it would produce, at any rate, some benefit by causing dilatation of the anastomosing vessels and thus diminishing the risk of gangrene, and influenced also by the published statistics of ligature of the femoral artery—which, I think, I have shown to be more unfavourable than the results of modern practice justify—many surgeons were in favour of persevering with pressure for a very considerable length of

[1] As to the use of Esmarch's bandage, however, in some exceptional cases, see p. 542.

[2] See two cases related by Tufnell on 'Aneurism,' pp. 120–130; and see also a lecture in the 'Lancet,' Dec. 12, 1874.

[3] Cases of successful ligature after the rupture of the aneurism may be found recorded in the 'Brit. Med. Jour.' 1859, p. 479 (where the aneurism had burst into the knee-joint); and one in the 'Lancet,' 1851, vol. ii. p. 30, where the aneurism (femoral) had burst through the skin. A case in which the femoral was tied with success after the rupture of the aneurism occurred a few years since under Mr. Stirling's care at St. George's Hospital.

time, and it is not to be denied that in many cases a cure has been so obtained,[1] but at the expense of an amount of suffering to which few persons would willingly submit unless in order to avoid some very great danger. And, as it seems, it is very problematical whether the danger is not the other way. Certainly the mortality after ligature of the femoral artery appears not to be diminished, but on the contrary, increased, by the previous unsuccessful trial of compression;[2] and, on the whole, I have been led to the conclusion that if no considerable improvement has been effected by the bloodless method in the first week, it is better to give up the attempt, allow the patient a few days to recover from the distress which the compression has probably caused, and then tie the artery.

In making compression I have myself no doubt whatever of the superiority of the digital over all other forms of pressure, if carefully employed; and I think the observation of Mr. Walker an important one, that the pressure should not be varied from the common to the superficial femoral and *vice versâ*, but should be applied to the same vessel throughout ('the one-artery system,' as he calls it), so that the same collaterals should always be called upon.

Ligature of tibial arteries.

Aneurism occurs below the popliteal space, but almost always from traumatic causes, or in cases of extensive disease of the heart and arteries.[3] Traumatic aneurisms of small arteries are best treated as recent wounds; and in the present day the use of Esmarch's bandage enables the surgeon to exclude the blood completely from the tumour, while he dissects out the vessels and ties them as easily as on the dead subject. Aneurisms the result of cardiac or general arterial disease are best let alone or treated by the mildest forms of compression. They are usually not in themselves very dangerous, and the patient's life cannot in any case be a long one. For these reasons operations on the tibial arteries, other than their direct ligature for wound, are amongst the rarest operations in surgery. In some very rare cases, however, one of the tibial arteries has been wounded from the other side of the leg by a stab through the interosseous membrane, and then it has been necessary to cut down formally on the artery according to the rules of the dissecting-room.

The posterior tibial can be secured near the ankle with facility, as it lies between the tendons of the tibialis posticus and flexor longus digitorum in its inner, and that of the flexor longus pollicis at its outer side. All that is necessary is to make an incision half-way between the internal malleolus and the heel and dissect the parts.

To secure the vessel higher up two different plans are adopted. Mr. Guthrie's has the advantage of enabling the surgeon to secure the peroneal artery, if his diagnosis should prove at fault and the wound or other lesion should implicate that vessel and not the tibial. A vertical incision is made in the centre of the calf about six inches long, through the gastrocnemius and soleus muscles, the deep or intermuscular fascia freely divided, and the

[1] See a remarkable instance of resolute persistence on the part of the surgeon and of the patient for the space of half a year, after which a cure was at length obtained, recorded by Mr. Walker of Liverpool.—'Liverpool Hospital Reports,' vol. v.

[2] 'Lancet,' May 1, 1875.

[3] See, however, two cases of spontaneous aneurism (or aneurism occurring without any known cause) in the dorsalis pedis artery, under the care of Mr. Adams and Mr. Savory, 'Brit. Med. Journ.' Dec. 8, 1877, and Jan. 19, 1878.

vessel sought immediately beneath this fascia superficial to the tibialis posticus muscle.

The old method of tying the posterior tibial is to make an incision parallel to the posterior border of the tibia, and about a finger's breadth behind it through the skin, superficial and deep fascia, exposing the tibial origin of the soleus muscle. This is then cut from the bone, the inter-muscular fascia is opened, and the artery found, with a vein on either side of it, and the nerve probably superficial to it. The artery is then separated from these structures, and tied.

The anterior tibial artery will be found in any part of its course by an incision in a line drawn from the head of the fibula to the central point

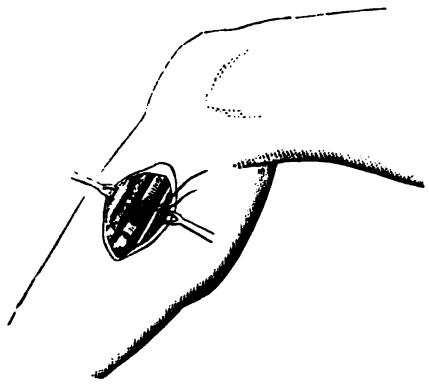


FIG. 264. Ligature of posterior tibial artery. The posterior hook draws aside the deep mass of muscles and the inter-muscular fascia. The vessels and posterior tibial nerve are seen lying on the tibialis posticus.

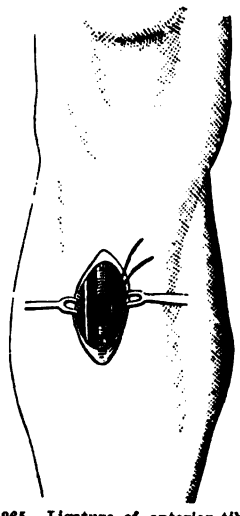


FIG. 265. Ligature of anterior tibial artery. The vessels are seen with the nerve lying in front and to the outer side.

between the two malleoli. At the upper part of the leg it lies very deeply, at the outer edge of the tibialis anticus muscle, in the septum of the fascia which shows as a white line, separating that muscle from the extensor long. dig. above and the ext. prop. pollicis in the middle of the leg. Success in this operation depends on hitting the edge of the tibialis anticus, for which purpose the surest way is to get the patient to put it into action before he is put under anæsthesia and mark it out, and to make the incision very freely, and carefully search for the white line before opening the fascia. The artery has venæ comites on either side, and the nerve external or superficial to it.

CHAPTER XXIX.

DISEASES OF THE VEINS AND ABSORBENTS.

Phlebitis and thrombosis.

THE leading symptom of phlebitis, or inflammation of veins, is the occurrence of coagulation in them, as evinced by hardness along the course of the vein. In true inflammation this is accompanied by pain and redness, and some amount of general fever. The mere coagulation of the blood in the veins by no means implies any inflammation, or any general affection of the system, or even any alteration in the tissues of the vein itself. Such passive coagulation of the blood in the veins used to be denominated 'adhesive phlebitis,' on the theory that the cause of the coagulation was effusion of lymph from the lining membrane of the vein; but it has been satisfactorily shown, both by clinical and anatomical observation, that in many of these cases there is no evidence of any inflammation whatever; and the direct experiments of Guthrie, Travers, H. Lee, and Callender in our own country, besides foreign observers, have shown that the lining membrane of the veins does not secrete lymph. Consequently the condition known to the older pathologists as 'adhesive phlebitis' is now usually designated more correctly as 'thrombosis.' It proceeds from a variety of causes—from pressure or obstruction to the return of blood, from diminished power of the circulation, from varicosity of the veins, from the extension into them of clots forming nearer the heart, and from conditions of the blood itself which are not as yet perfectly understood. Thus, in the thrombosis which occurs in the veins of the lower extremity after parturition, and to which the name of 'phlegmasia dolens' is applied, the coagulation which has necessarily taken place in the uterine sinuses extends down the iliac, femoral, and other veins. In fractures where a vein has been contused or torn the coagulation so produced often extends into the lower veins and impedes the union of the fracture.[1] And sometimes we see cases in which, with no definite local exciting cause (though commonly in some condition of general disease), the veins become blocked, often to a very great extent. The same passive coagulation or thrombosis occasionally, though rarely, happens in the pulmonary arteries, and is a recognised cause of sudden death,[2] and there can be no doubt that similar passive coagulation of blood in the cavities of the heart occasionally produces death. The first symptoms of thrombosis are a sense of uneasiness and an aching pain in the parts affected, followed by some difficulty in moving the limb. On examination a hard cord is felt in the place of the vein affected, which is somewhat tender on being handled, and there is general swelling and œdema of the limb.[3] The affected vein is sometimes though not always sur-

[1] See Callender, 'Med.-Chir. Trans.' vol. li.

[2] The reader will find a very interesting account of these cases of thrombosis in the superficial veins, the cerebral sinuses, the cavities of the heart, and the pulmonary arteries, in a paper 'On the Coagulation of the Blood in the Venous System during Life,' by Dr. Humphry, republished in 1859 from the 'British Medical Journal.'

[3] Mr. Savory, in an interesting clinical lecture on phlebitis ('Brit. Med. Journ.' Feb. 9, 1878) states his belief that the cases of phlebitis which commence with local pain and tenderness are those in which the superficial veins only are affected, while in those which are marked only by œdema the deeper veins are obstructed.

rounded by inflamed cellular tissue. If there is an opportunity of examining the vein it will be found filled with coagula, which are more or less adherent to its inner surface. The coagula are of a variable or mottled colour, almost black in some places, in others nearly decolourised, and generally the decolourised parts are firmly connected to the lining membrane, while the central portion of the clot is, on the contrary, often broken down into a creamy fluid, looking like a mixture of blood and pus. In some cases, even when the obstruction of veins is great, no constitutional disturbance can be traced. There is no feverish excitement, no change in the normal temperature or pulse, and the affection subsides spontaneously as it arose—the vessels regaining their natural appearance, and the functions of the limb being completely restored. But this is not always the case, though I believe it is by far the most frequent termination of the disease, Whether along with or, as seems more probable, in consequence of the coagulation,[1] the walls of the vein and the cellular tissue which support it become inflamed, and this inflammation is often accompanied with severe pain and with much constitutional disturbance, and the serious symptoms may ensue which are described as acute or suppurative phlebitis, and which are often developed by severe injuries, such as amputation or excision, when the cavities of large veins have been laid open, and especially those veins which, being contained in bony canals, are incapable of closure, and thus of immediate union.

The anatomical characters of phlebitis are perceived partly in the cellular tissue which supports the vein, partly in the coats of the vessel itself, and partly in its contents. The disease consists—in some measure at least—of diffuse inflammation spreading along the cellular membrane in which the vein lies. Hence the redness, hardness, and œdema which are seen during life in the course of the affected vessel. Although this inflammation most commonly extends in the course of the circulation, cases are not wanting in which it spreads towards the distal veins. In this inflammation the outer or cellular coat of the vein participates. Coincidently with this the tissues of the vessel itself become altered. 'The circular fibrous coat becomes injected and thickened by deposit; the inner coat loses its natural transparency, and becomes wrinkled and even fissured. It is of a dull, opaque, dirty white colour, stained more or less by the contents of the vein; exudation often occurs between the inner and outer coats, and the different layers of the former then become disintegrated, or the lining membrane may be cast off in large portions into the interior of the vessel. All the coats of the vein may, under these circumstances, be easily detached from each other, or may be separated by serous, fibrinous, or puriform exudation. When these form under the lining membrane they may be seen as patches of various sizes and shapes through the transparent structure, so long as this retains its integrity. Afterwards they may be poured, together with the fragments of the disintegrated membrane, into the cavity of the vessel. The inflammatory exudation between the different coats of the vein destroys its natural pliability, so that when divided it will remain open like an artery.' (Lee, op. cit. p. 25.) So much for the anatomical changes in the vein itself. Along with this there are changes in the blood contained in it. We have seen that the blood may clot in the veins without any previous inflammatory symptoms or appearances, and sometimes without any subsequent bad consequences (thrombosis), but we

[1] 'Coagulation of the blood in a vein,' says Mr. Lee, 'may be either a primary or secondary affection: it may be either the cause or the effect of the inflammation of the coats of the vein.'—'Practical Pathology,' 3rd ed. vol. i. p. 24.

have also seen that this obstruction of the vein may, on the other hand, prove the starting-point of inflammation of its tissue. Coagulation may also follow on injury to the vein, or on the passage into its cavity of any irritating or decomposing matter. In such cases the coagulation is to be regarded as salutary—a barrier thrown up against the passage of the products of inflammation or decomposition into the mass of the circulating blood. Should this barrier hold, as in the very great majority of cases it does, the inflammation will be limited to the part first affected, the general symptoms which may have been excited will subside, and the patient recover. But the coagulum often breaks down and softens into a creamy puriform fluid, resembling sanious pus to the naked eye, but only showing under the microscope granular matter and disintegrated blood-cells; and when this matter passes into the general current of the blood it may spread the inflammation of the vein to an indefinite extent, or may produce the general symptoms and signs of septicæmia or pyæmia, or may lead only to local embolism.[1] And, lastly, as clotting in a vein and the decomposition of the clots sometimes excites the general symptoms of pyæmia, so, conversely, the passage of putrid matter into the blood—septicæmia—often is the cause of clotting and of decomposition of clot in the remote veins. As Mr. Lee phrases it, 'the decomposition, originating in a local action, may infect the general mass of the blood and rapidly kill the patient, without the occurrence of any blood-clotting; or coagula may form in the vessels, disintegrate and decompose, and become conveyed to other parts. In the last instance the phenomena of thrombosis and afterwards of embolism become superadded to the original septicæmia' (op. cit. p. 58).

Various kinds of phlebitis.

The kinds of thrombosis and phlebitis, ranked according to their causes, are enumerated by Paget as: (1) the traumatic, including those due to distension; (2) those occurring in exhaustion, during or after either acute or chronic disease; (3) those due to extension of inflammation, or of blood-clotting from ulcers, morbid growths, or gangrenous or acutely inflamed parts;[2] (4) those of the so-called idiopathic or rheumatic form; (5) the pyæmial; (6) the puerperal (among which it is probable that examples of all kinds, only modified by the puerperal state, are grouped); and (7) the gouty.[3]

The symptoms above stated will suffice for the diagnosis of phlebitis whenever the vein is superficial; in fact, the only disease with which it could be confounded is inflamed absorbents, but the latter is not accompanied by the œdema of phlebitis; the red inflamed streaks are much narrower, and there is always, if not enlargement, at any rate tenderness of the glands above.

Treatment of phlebitis.

The treatment of phlebitis must in general be merely expectant, any concomitant constitutional or general disorder being, of course, treated according to its own indications. Strict rest must be enjoined and in many cases must be long persisted in; the part must be put in such a position as will favour the return of blood; warm lotions are generally grateful, and possibly may be useful in favouring the distension of the cellular tissue and avoiding tension. If there is much diffuse inflammation around the affected

[1] Mr. Savory's lecture above referred to may be consulted for interesting cases in which, though the transference of disease from one part to another by disintegration of the clot seems indisputable, yet no general pyæmic symptoms were produced. In fact, Mr. Savory regards pyæmia as a rare sequela of phlebitis.

[2] See Fig. 189, p. 417.

[3] 'Clin. Lect.' p. 293. Sir J. Paget's essay gives an interesting sketch of gouty phlebitis distinguished chiefly by its symmetry, apparent metastases, and frequent recurrence. Sir Prescott Hewett has also described the same form of phlebitis in 'Clin. Soc. Trans.' vol. vi.

vein incisions will be necessary. The administration of mercury and free leeching around the inflamed vein used to be much practised, but their generally weakening effect causes more constitutional mischief than is counterbalanced by any local benefit they produce. Pain must be soothed by opium, and in rheumatic and gouty cases alkalies will be indicated.

Finally, there may be cases where the surgeon may think it justifiable to hinder the progress of the inflammation and defend the patient from the danger of the passage of the decomposing clot into the mass of the blood by putting two needles beneath the vein and dividing it in the interval, a practice of which Mr. Lee has given some interesting examples, apparently successful, though of course it will be only rarely that such a complication to an already dangerous malady will be considered appropriate, and frequent failure in checking the course of the disease must be anticipated.

Varicose veins.

Varicosity or dilatation of veins is an exceedingly familiar affection as seen in the veins of the lower limb. It very commonly affects the veins of the spermatic cord, forming the disease known as varicocele. Many piles consist wholly or in part of varicose hæmorrhoidal veins, and other superficial and deep veins are occasionally found to be varicose. Dilated, tortuous, and varicose veins are also not unfrequently found ramifying under the skin and forming a collateral circulation in cases where any large trunk vein is obliterated. Thus, when the vena cava inferior has been plugged, large veins are developed under the skin of the abdomen, which bring the blood from some of the radicles of the obstructed vein into those of the superior vena cava, while the azygos circulation is no doubt also enlarged to convey the remainder.

The diseases caused by varicosity of special veins, and admitting of surgical treatment, will be found described in other chapters, as VARICOCELE and HÆMORRHOIDS. We will deal here with varix of the lower extremity.

This may arise from any cause which throws too great or too continuous a strain on the veins, or which obstructs the return of blood from them. Thus, long-continued standing, especially in a heated atmosphere (as is done by soldiers, cooks, washerwomen), the pressure of garters, ill-fitting trusses, tumours, collections of fæces in the sigmoid flexure, the gravid uterus, want of support to the veins from relaxation of the tissues which should support them, are recognised causes of varix: and much may therefore be done in an early stage of the disease to mitigate or even to cure it by a removal of its cause.

The first effect of long-continued pressure on a vein is, of course, its dilatation. This dilatation, when not carried too far, or continued too long, is susceptible of complete recovery by the natural elasticity of the tissues which form and those which support the vein. But if it be carried too far the vein becomes permanently dilated, the valves cease to be adequate to close its tube, and the pressure is therefore transmitted to a lower part of the trunk, which thereby becomes similarly affected, and so a long track of the vein becomes permanently varicose. But there are other cases in which the dilatation affects only a small extent of the whole vein, and even some very rare ones in which only a portion of the calibre is dilated into a circumscribed tumour exactly resembling an aneurism.[1] Further changes follow on this dilatation of the vein. In the first instance the coats of the veins are probably rendered thinner by their distension, and there are cases in which they remain

[1] There are two preparations of this condition in the Museum of St. George's Hospital.

thinner, and some in which they give way altogether; and the skin over them being also absorbed by the pressure of the varix, or ulcerated, external hæmorrhage results. In other cases the dilatation produced by the pressure causes thickening of the varicose vein. The skin is often greatly affected in this disease. The obstacle to the return of the blood causes congestion, followed often by low inflammation and ulceration. Hence varicose veins are the most prolific of all the causes of ulcer of the leg.

The superficial veins are chiefly affected, but it has been satisfactorily proved that the deep veins are not exempt, though the firm support which they receive from the muscles and fasciæ amongst which they lie prevents their attaining the size which the superficial veins do. This enlargement of the deep veins is testified by a general increase in the size of the limb, independent of the swelling of the superficial vessels, and by the sense of weight and aching on hanging it down. And the occurrence of varicosity in the deep veins (though doubted by Mr. Callender) has been directly affirmed by Verneuil, who has put up some preparations in the Musée Dupuytren to show it.[1]

Treatment. The treatment of varicose veins must be either palliative or radical. It has been pointed out above that in an early stage of the disease complete recovery may follow on the removal of the cause, the strengthening of the general health, so as to improve the tone of the tissues, and the unloading of the affected vein by rest in the raised posture. And even when the veins have been for some time varicose, if the disease has not progressed very far, rest in the raised position for a considerable time—say a month—and the application of firm but soft bandages, will often produce the complete disappearance of the enlargement and relief of the symptoms. Still it is prudent to enforce the wearing of a well-fitting bandage or elastic stocking for a long while, and particularly during any strong exercise. When the enlargement has lasted long, and the veins have become much thickened, complete recovery cannot be expected, but much improvement may be procured by proper and well-fitting bandages and stockings.

The cases in which operative interference is desirable are not numerous, for it has been abundantly shown that if one varicose cluster is cured another will often, if not always, form,[2] and also that very much improvement may be obtained by rest and appropriate treatment even in the worst cases, so much as usually to allow complete relief to the symptoms, by proper apparatus. Now, as the same apparatus will be required even after the most successful operation, it may fairly be argued that the pain and risk of the latter have been superfluous. I admit this to some extent. Still the operation is very much less formidable than that for varicocele, and it certainly gives speedy and effectual though possibly only temporary relief in many cases where there has been great pain, or where the patient has been much troubled with ulcera-

[1] A recent writer (Giacomini—see 'Lond. Med. Record,' March 4, 1874) even goes so far as to say that varicosity of the superficial veins is always secondary to a varicose state of those deeper veins (inter and intra muscular) which establish a communication between the trunk veins accompanying the arteries and the subcutaneous vessels—the radicles of the saphenous. But the most complete and most suggestive account of the anatomy of the venous system is to be found in a series of papers by Mr. Gay, in the 'Lancet,' 1877, vols. i. and ii. which I earnestly commend to the reader's attention.

[2] Sir B. Brodie says: 'I always observed that if I cured one cluster two smaller ones appeared, one on each side, and that ultimately I left the patient no better than I found him.' —Works, vol. iii. p. 254. This, however, is certainly not always the case. I have seen patients quite well several years after the operation.

tion or inflammation of the skin. There are very numerous operations in use for varicose veins, but I will only describe that which my colleague Mr. H. Lee has introduced at St. George's Hospital, which is very easy, very efficient, and after which I have not as yet seen any serious accident. The vein is divided subcutaneously, while it is compressed above and below the point of division long enough to ensure its obliteration, but not long enough to allow any ulceration of the vein. Hence there is no way left by which any of the products of putrefaction or decomposition (should any such products form in the subcutaneous puncture) can pass into the cavity of the vein.

Subcutaneous division of varicose veins.

Two pins are to be passed under the vein, at a distance of about an inch from each other; and in doing so great care must be taken to lift the vein well up, and pass the pin below the vein and not through it. Compression is then made by twisting a figure-of-8 ligature round the pins or by a piece of indiarubber, through which the pin is thrust before it is introduced, and which is then drawn over its point. Then a thin knife, a little longer and stronger in the blade than a tendon-knife, is passed under the vein, and the latter completely divided without cutting the skin.[1] Two or three circular pieces of plaster, encircling the whole leg, are then firmly applied over the puncture and the divided ends of the vein, and the patient is kept in bed, with the limb raised, for a week or ten days. The pins are removed at a time varying from two to five days. The former time is quite enough when all goes well and there is no excess of action round the subcutaneous wound: but if this should take place the surgeon may think it safer to keep up compression longer. The plaster need not be moved, unless suppuration is found to be going on. After the above time a bandage may be carefully applied, and the patient allowed to move about a little in the house. Then a well-fitting elastic stocking should be worn. If there is an ulcer the patient should be kept in bed till it heals.

Excision of varices.

There are cases in which a large varix exists in a limited extent of vein, and a few in which a circumscribed rounded tumour is formed by a varix, exactly like an aneurism, and almost deserving the name of 'venous aneurism.' In such cases it is quite justifiable to excise the varix, tying the vessels which communicate with it with carbolised catgut, and conducting the whole operation with every precaution against subsequent inflammation. In the few cases which I have seen the operation has been followed by no bad results.

Other affections of veins.

There are a few other affections of veins which, however, are more pathological products than surgical diseases. Thus, from degeneration of clots small chalky[2] concretions, called 'phlebolithes,' are found in the cavity of veins, and such concretions may not uncommonly be recognised during life in the spermatic veins. I am not aware that they ever produce any symptoms or require removal.

The veins are peculiarly liable to hypertrophy and atrophy, according as the variations of the circulation throw the blood into anastomosing channels or the removal of parts deprives the veins of their chief function.

[1] Sir B. Brodie introduced the practice of dividing the veins subcutaneously. Mr. Lee added the temporary compression above and below, which so greatly tends to the patient's safety.

[2] They consist, according to an analysis made for Mr. Callender by Dr. Frankland, of phosphate of lime, with some sulphate of potash and sulphate of lime, intermixed with protein substances from the blood.

Calcareous degeneration of veins is also spoken of, but it seems doubtful whether it is not usually a peculiar arrangement of phlebolithes. No disease is known in veins corresponding to the atheroma of arteries.

Malignant tumours frequently grow into veins; and every museum contains specimens of cancer protruding into the cavity of some large vein.

DISEASES OF THE ABSORBENTS.

Lymphatic fistula.

THE absorbent vessels are, though very rarely, the seat of fistulous openings, through which their secretion is poured out on the surface of the body. This occurs more often in the groin, scrotum, and labium than in any other part, and is sometimes the result of a wound; at other times it proceeds from a varicose condition of the vessels, the cause of which is obscure, but which is often associated with elephantiasis of the lower part of the limb.[1] Dr. Vandyke Carter has noticed that in a case of 'chylous urine' a quantity of lymph was poured out of a minute opening in the thigh, and he believes that in some at least of these cases there is a preternatural communication between the receptaculum chyli or some of its large branches and the urinary passages, complicated with obstruction of the main lacteals and a varicose state of the lower lymphatics.[2]

Beyond attention to position, careful pressure by strapping or bandages, and avoidance of accumulation in the bowels, I do not see what can be done in such cases.

Inflammation of the absorbents and of the glands.

The commonest surgical affection connected with the lymphatic system is the inflammation which so commonly attends wounds, whether poisoned or no, and which affects either the absorbent vessels themselves (inflamed absorbents—angeioleucitis) or the glands (inflamed glands—adenitis), or both.

Inflammation of the absorbents is usually excited by a wound, but it occurs also, as has been mentioned in the section on ERYSIPELAS, p. 41, as an idiopathic affection premonitory of that disease, or one of its earliest symptoms. If severe, the disease commences with considerable fever and rigors; soon red lines are seen running up the course of the lymphatics, and terminating at the nearest gland. This is often accompanied by sharp pain, and always by great tenderness. The redness and tenderness are easily distinguished from those which are found in phlebitis, inasmuch as the lines, though much thicker than the absorbent vessels, are far less extensive than would be caused by inflammation of the cellular tissue around the veins, and the red streaks run in the course of the absorbents, not in that of the veins. The redness in all cases ceases at the gland or glands to which the absorbents run; and those glands are tender, red, and hot, and they are very liable to suppuration, which involves mainly the cellular tissue around the gland, and which on its subsidence does not seem to leave the gland permanently impaired in function, though, no doubt, suppuration takes place in the tissue of the gland, as well as in that which surrounds it. In rare cases there are abscesses in the course of the lymphatic before it reaches the gland.

Inflammation of a gland, however (adenitis), occurs constantly without

[1] Some other hypertrophic diseases besides the common elephantiasis are now believed to depend on a similar enlargement of the lymph-channels, e.g. macroglossia.

[2] 'Med.-Chir. Trans.' vol. xlv.

any previous inflammation of the lymphatics which supply it, as we see every day in the cervical glands, in the bubo of gonorrhœa and syphilis, and in a thousand other cases.

The inflammation, or bubo, seems in all cases conservative—the products of inflammation are resolved in the gland, and instead of passing into the mass of the blood to excite fermentation and septicæmia, they are expended in the production of an abscess which, in all ordinary cases, is a mere local trouble. There are, of course, exceptions to this, and they have been already alluded to in the chapter on Poisoned Wounds (p. 67), but it remains true that inflammation of the absorbent glands is a safeguard against the passage of poisonous material into the blood, and one which, considering the constant occurrence of the danger, is very efficient.

The treatment of inflamed absorbents is generally very simple. If the inflammation is of moderate severity, the application of nitrate of silver in a strong solution (gr. x–xv to the ounce) or pencilling them lightly with a stick of caustic, after wetting the skin, seems useful. I have seen much benefit from the application of mercurial ointment over the inflamed vessels, but it is very apt to salivate; and, after all, the inflammation of the vessels themselves almost always subsides spontaneously. The use of warm opiate lotions is generally grateful. The bowels should be freely purged; and the general treatment should be the same as for erysipelas, to which this disease bears such a close relationship.

Inflammation of the absorbent glands requires the same general treatment. Locally, warm poultices are the best application. It is an error, I think, to believe that poultices promote suppuration; on the contrary, they seem to prevent it, when it is preventible, though when it has commenced they soften and relax the tissues, and facilitate the progress of the matter towards the skin. As soon as matter is detected the abscess should be freely opened.

If the inflammation remains long in a chronic state nothing is so useful as a blister. In some cases it causes the recession of the inflammation and subsidence of the glandular enlargement; more commonly it brings the abscess to a head.

Affections of glands in various diseases.

The glands sympathise, or more properly speaking are involved, in a great number of different kinds of inflammatory and constitutional diseases—in struma, syphilis, and cancer especially. In all these diseases the affection of the glands is, as a general rule, secondary to a similar affection in the soft parts from which they are supplied, but in struma the glands are very often affected with little evidence of any such primary disease, and in constitutional syphilis they are often enlarged without any affection of the parts from which they are supplied. Still it is prudent in all cases of strumous or syphilitic enlargement of glands to examine narrowly all the parts from which they derive their absorbents, for assuredly the glandular affection will be most easily treated by the cure of that on which it depends.

Strumous glands are most common in the neck, and often constitute a disease by themselves. It is understood that the absence of eruptions of the scalp, caries of the teeth, &c., has been ascertained, and that the surgeon has satisfied himself that the glandular disease is the specific object of treatment. In this, as in all other strumous diseases, the surgical treatment should not be too active. If the glands be merely in the ordinary condition of chronic enlargement the only local application they will require will be slight counter-irritation with iodine, or light touches of the actual cautery, or flying blisters,

i.e. blisters which are allowed to dry up at once while another is applied close by. Glands in this condition are usually the seats either of definite tubercular deposits or of low inflammation. In the former case abscess is very probable, though it is, of course, possible that the tubercle may calcify or become indolent. In the other case the gland may return entirely to the healthy condition. The remedies prescribed for scrofula (page 366) must, of course, be employed, and when suppuration is plainly perceived a small incision should be made, or exit given to it by a seton of a single thread, which often affords a vent for the pus with but little resulting deformity. If the abscess is left to find its own way out it often leaves several depressed cicatrices, or, worse still, a heaped-up strumous scar (page 407).

The treatment of syphilitic glands resolves itself into that of the constitutional affection on which it depends. Cancerous glands usually admit of no treatment, unless the surgeon thinks fit to regard them as part of the primary tumour and extirpate them along with it.

It is, however, hardly ever desirable to operate on enlarged glands, otherwise than as a part of an operation for cancer. I have seen strumous glands extirpated, and have myself performed such operations; but though I have occasionally obtained good results, it has been at the expense of difficulty and danger far out of proportion to the advantage, and I would strongly dissuade the attempt, unless in very exceptional circumstances.

Mr. Treves[1] speaks favourably of the results of operations on strumous glands with the thermo-cautery, which he thus describes: 'I use a fine point of the thermo-cautery about the size of a No. 7 catheter. This, being heated to a bright red heat, is thrust through the skin into the substance of the gland, and is passed in several directions through the gland-tissue before it is withdrawn. If there are any purulent collections in the tumour, they have free exit. The hole formed by the cautery remains patent for some time, and allows any broken-down tissue to be discharged. As a rule, very little reaction follows. In many cases scarcely any discharge follows the application of the cautery point, but the gland in a few days begins to shrink and very commonly ceases to give any more trouble. In only one instance out of some twenty did the skin become undermined. This procedure is applicable to almost any glands that have attained the size of a walnut, and answers admirably in the case of large adherent lobulated masses. It is not applicable to gland tumours that are still freely movable.'

Lymphadenoma.

Finally, we must speak of a peculiar hypertrophic disease of the lymphatic glands, first distinctly described by Dr. Hodgkin,[2] and often called after his name 'Hodgkin's disease,' but now more commonly spoken of as 'Lymphadenoma,' 'Lympho-sarcoma,' or 'Lymphoma.' The enlargement affects usually the cervical glands, sometimes those of the axilla also, sometimes the glands in many parts of the body. The blood-glands are also often affected, particularly the spleen and thyroid, and there may be thus combined with the glandular disease the condition known as 'leucocythæmia,' in which the elaboration of the blood is imperfect, so that the white cells are disproportionately numerous.[3] Finally, the same disease affects the lymphatic channels in many parts of the body, forming tumours in the lungs, liver, and

[1] 'System of Surgery,' 3rd edit. vol. i. p. 233.

[2] 'Med.-Chir. Trans.' vol. xvii.

[3] There are many cases, however, in which no such condition of the blood exists.

other organs,[1] which are believed to depend on deposit of adenoid tissue in the cellular membrane enveloping the lymphatic vessels. This deposit consists of cells exactly resembling those of the lymph, arranged more or less concentrically in a transparent stroma, and often grouped around a blood-vessel, the whole presenting a great resemblance to the glands in the condition described by Dr. Sanderson as 'fibroid induration,' the result of chronic inflammation.[2]

Lymphadenoma is nearly allied to phthisis, being apparently a similar deposit in lymphatic tissue to that which in phthisis surrounds the ultimate blood-vessels. It proves fatal in various ways, by the local effects of its deposits in the viscera, by its effects on the blood, by general exhaustion, and sometimes by a peculiar fever.

Treatment is, however, successful in some of the milder cases. It consists in attention to the general health, sea air, and the local and general administration of iodine. Surgical operations are possibly justifiable in early conditions of the disease, and where it is limited in extent; but it must be admitted that they have hitherto proved disappointing.

[1] The disease is described in the medulla of the bones by Mr. Macnamara ('Dis. of Bones and Joints'), and in the testicle by Monod and Terbillon ('Arch. Gén.' July, 1879).

[2] The whole subject of lymphadenoma was summarised in an excellent paper by Drs. Murchison and Sanderson, in 'Path. Trans.' vol. xxi. p. 372, where the reader will find a complete account of the literature of the subject, as well as microscopical and other anatomical details. Two interesting and well-described cases by Dr. Greenfield and Dr. Goodhart in the 'Clin. Soc. Trans.' vol. x. should also be referred to.

CHAPTER XXX.

SURGICAL DISEASES OF THE HEAD AND FACE.

CONGENITAL MALFORMATIONS.

Harelip.

HARELIP is one of the commonest of all the congenital deformities. It is named from the general resemblance which no doubt it bears to the cleft lip of the hare; though, as Sir W. Fergusson remarks, the resemblance fails in this important particular, that the cleft in the hare's lip is in the middle line, which it hardly ever is in the malformation.[1] It is often hereditary, and in children who suffer from it, or in members of the same family, other deformities are often found. (See a remarkable instance in Cooper Forster's 'Surgical Diseases of Children,' p. 80.) Harelip may be divided into simple, double, and complicated.

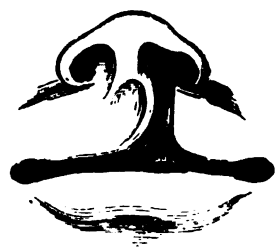


FIG. 266. Diagram of the common single harelip.—Holmes's 'Surg. Dis. of Childhood.'

In simple harelip there is a cleft through the upper lip,[2] on one side of the middle line, but no other deformity. The cleft, for some unknown reason, is usually on the left side, and it generally extends from the nostril to the free edge of the lip. The nostril also is expanded on the affected side. These features are shown on the appended diagram, which shows also what is very common in harelip, viz. that the vertical extent of one side of the cleft is less than that of the other.

In some cases this inequality is still more marked; and in others, again, the two halves of the lip lie on different levels (Figs. 267, 268).

The cure of the simplest cases of this deformity is very easy. Nothing is required except to pare off an amount of tissue from either side of the cleft sufficient to refresh the whole thickness of the lip on both sides, and then to bring the two sides together with the harelip suture. Before paring the edges it is well to turn out the two parts of the lip, and divide any adhesion to the jaw which might possibly displace either half. A few points in this little operation call for more detailed notice. 1. As to the age at which to operate. In simple cases there is no reason at all why the operation should not be done at the earliest age at which the infant is seen. It has even been done on the first day of life; but this is hardly desirable; and as there is no hurry (for the defect occasions no impediment to suckling), it is, on the whole, better to wait till the child is two or three months old, and is seen to be healthy and vigorous. Weakly infants should not be operated on, as a general rule. 2. As to administering chloroform or ether. This seems to me unnecessary, since the operation is so soon over; but there is no objection to it if the

[1] In one instance of extensive deformity figured by Mr. Pollock ('Syst. of Surg.' 3rd. ed. vol. ii. p 501) the cleft was in the middle line, and Rokitansky refers to another case; but both these were instances of complete cleft of the palate, and the incisive bone was absent. I have, however, heard of a case in which simple harelip was median.

[2] As surgical curiosities clefts of the lower lip or clefts of the cheek have been recorded.—See Holmes's 'Surgical Diseases of Childhood,' 2nd ed. p. 127.

...on or the parents prefer it. 3. As to the attitude in which the child is ... placed. I prefer the sitting posture in the arms of a steady nurse or other ...stant. If the recumbent position be adopted (which some surgeons prefer) ... surgeon sitting and holding the child's head between his knees, it is often ...cessary to suspend the operation in order to disembarrass the infant of blood which has passed into the mouth; and thus the operation is protracted, and more blood is lost. And the passage of blood down the throat is even more to be apprehended when the operation is performed under anæsthesia, and constitutes, to my mind, an objection to the use of anæsthetics. 4. As to the stoppage of bleeding. Very little blood will be lost if a handy assistant compresses the two sides of the lip between his finger and thumb. The flaps must be released just when the needles are passed, if needles be used; but the amount of blood thus lost is very trifling. A pair of double forceps has been introduced by Mr. T. Smith for holding both sides of the lip with a sort of clamp, and this may be useful in the absence of a trained assistant; but, as a general rule, it is superfluous. 5. As to the instruments. I much prefer the knife; some surgeons, I believe, still use scissors, which are inferior, inasmuch as they only allow of a single straight incision, whilst, as I shall



FIG. 267. A drawing from life of a harelip with unequal sides.—Holmes's 'Surg. Dis. of Childhood.'



FIG. 268. Harelip showing the two parts on different levels as well as unequal.—Holmes's 'Surg. Dis. of Childhood.'

presently show, it is often necessary to modify the direction of the incision in various ways. 6. As to the suture. 'The harelip suture' will be found figured in the chapter on 'Minor Surgery,' and it is a very efficient and secure method of holding the parts together till union is complete. But it has the drawback that the needles may make a small scar at each of their points of puncture. This usually depends on their having been kept in too long. If withdrawn, as they should be, in forty-eight hours, they usually leave no mark, and it seems useless to keep them in longer than this, since they are more likely to do harm by setting up suppuration than good by keeping the parts in apposition. However, if the lip is small, there is no real need for the needles. The interrupted or continuous suture answers perfectly, and is best made of silver wire. Some surgeons prefer to clamp the wire with shot, or with a button of some kind.[1] But whatever be the material or form of the suture, it is essential that it should bring the whole of the lip in apposition, i.e. that the suture should be placed close upon the mucous membrane, and that for two reasons. First, that as the coronary arteries lie between the

[1] An ingenious clamp was lately introduced by my colleague Mr. Pollock under the name of the 'gun-nipple button.'

muscles and mucous membrane a too superficial suture might leave them uncommanded, and they would bleed into the mouth; and, secondly, that if the whole lip were not brought together the resulting cicatrix might be too weak to bear the traction of the muscles and might give way. Generally a fine suture at the edge of the lip is necessary in order to maintain the perfect evenness of the red line there.

The child should be put to the breast as soon as the operation is over, and very soon forgets it.

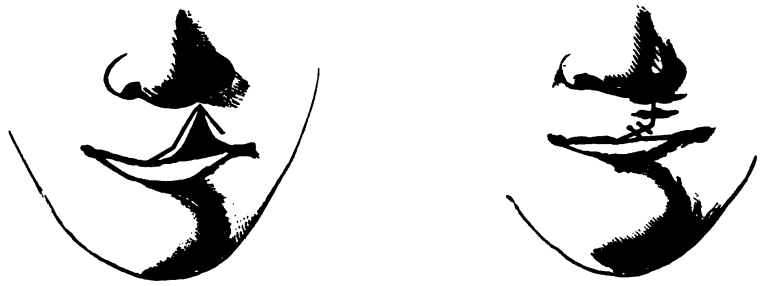


FIG. 269. Operation for harelip with unequal sides, by leaving one of the pared edges (that on the left side) attached, and implanting it into the opposite flap, the edge of which has been sloped to receive it.—Holmes's 'Surg. Dis. of Childhood.'

After two days the whole of the suture should be well oiled and withdrawn, the two parts of the lip being held firmly together with the fingers, while two or three long straps of plaster are applied, taking hold of the cheeks by means of broad ends, while their narrower central parts cover the wound.

In cases where the inequality between the two parts is great the simple operation will not give a satisfactory result. It is then better to leave the flap on the narrower side attached by its base, and to slope off the incision on the broader side, as shown in Fig. 269. The flap left attached on



FIG. 270. Diagram of Clémot's operation for incomplete harelip. *a* shows the furrow which unites the two halves at the lip; *b* the incision on one side, which runs down towards but not to the red edge of the lip. The second figure shows these flaps drawn down and the suture which unites this wound, which is now of a diamond-shape.—Holmes's 'Surg. Dis. of Childhood.'

the narrower side is implanted into the broader flap, and fills up the gap which would otherwise be left. Of course, if the pendulous flap seems too large for the gap, it may be trimmed away as much as necessary. In other cases, where both sides of the cleft are much inferior in depth to the rest of the lip, both flaps or portions of them may be left attached at their lower part, turned down, and sewn together, so as to form a prominent tubercle. This tubercle, though it may appear redundant at first, will gradually become modelled down.

Incomplete cleft.

Closely allied to this operation (which bears the name of Nélaton) is a proceeding introduced by M. Clémot for the cure of cases of incomplete hare-

lip, i.e. clefts which do not extend into the nostril. It consists (Fig. 270) in making an incision like a V reversed around the cleft, leaving both flaps attached at their base, and drawing them down, so as to form a diamond-shaped wound, which is then sewn together, and thus a considerable protuberance is substituted for the cleft.

Double harelip.

Uncomplicated double harelip is not a very much more serious malformation than single harelip; at least, it is almost as easy to cure by operation, though the deformity left will probably be greater. In this form of malformation there is a median tubercle, bounded on either side by clefts, of which very commonly one reaches into the nostril, while the other does not, or both may be complete. The nose is depressed and the nostrils widened. The incisive bone, which corresponds to the median tubercle, carries generally four teeth, but their number varies. In uncomplicated harelip there is no actual fissure in the bony palate, nor any malposition of the os incisivum, though some trace of a cleft on one or both sides is not infrequently noticed on close examination.



FIG. 271. Diagram of double harelip.—Holmes's 'Surg. Dis. of Childhood.'

The operation for uncomplicated double-harelip consists in paring both sides of the median tubercle by two incisions meeting in a point below, so as to leave in the centre a triangular piece, with its base upwards. The edges of the two lateral portions of the lip are then pared, and these pieces attached above to the central piece, and below this (for the central piece is always narrower than the rest of the lip) to each other. As there is often, if not always, considerable traction on this lower part, and a gap or fissure generally exists after this simple operation, it is often advisable to leave part or the whole of the lateral flaps attached and to implant them into each other, to fill up the gap.

Complicated harelip.

Harelip, either single or double, may be complicated with fissure of the palate, and when this is the case in double harelip the incisive bone often projects considerably, and appears to hang on to the end of the nose (Fig. 273). In such cases, or in single harelip when the two portions of the jaw are on a different level (Fig. 268), the gap may be very wide, and there will be much difficulty in filling it up. Hence the importance of not removing any of the already existing tissue if it can possibly be saved and made available for that purpose. It would be out of place here to describe all the ingenious operations which have been invented for the cure of complicated harelip. I will limit myself to two or three of the more useful. In cases with very extensive cleft, or with a projection of one portion of the jaw, the 'operation of Giraldès'[1] will be found useful. Flaps are cut on either side, and are left attached on one (the right in the diagram) by the lower, on the other (the left in the diagram) by the upper end, the incisions being carried round the nose as far as may be deemed necessary (Fig. 274). The flap, attached by its lower end, is then turned downwards, so that its red edge forms the border of the lip, while the other is drawn upwards, towards the nostril, and they are thus dovetailed together with interrupted sutures. If the surgeon thinks it safer he can support his sutures for a day or two by a harelip-pin in the centre.

[1] 'Leçons cliniques sur les Mal. Chir. des Enfants,' 1868, pp. 155–6.

When the median tubercle projects (Fig. 273) it is often removed with the cutting-pliers before the operation, the skin covering it being saved, either to fit into the gap or to sew on to the central incision and help to form the columella; and if the projection be very great and the portion of bone much isolated it may be well to follow this course. But if the incisive bone can be preserved it will be found useful in preventing the extremely disagreeable underhung appearance which its removal gives to the profile.[1] There are



FIG. 272. Front view of double harelip with projection of intermaxillary bone.



FIG. 273. Side-view of the same case.—Holmes's 'Surg. Dis. of Childhood.'

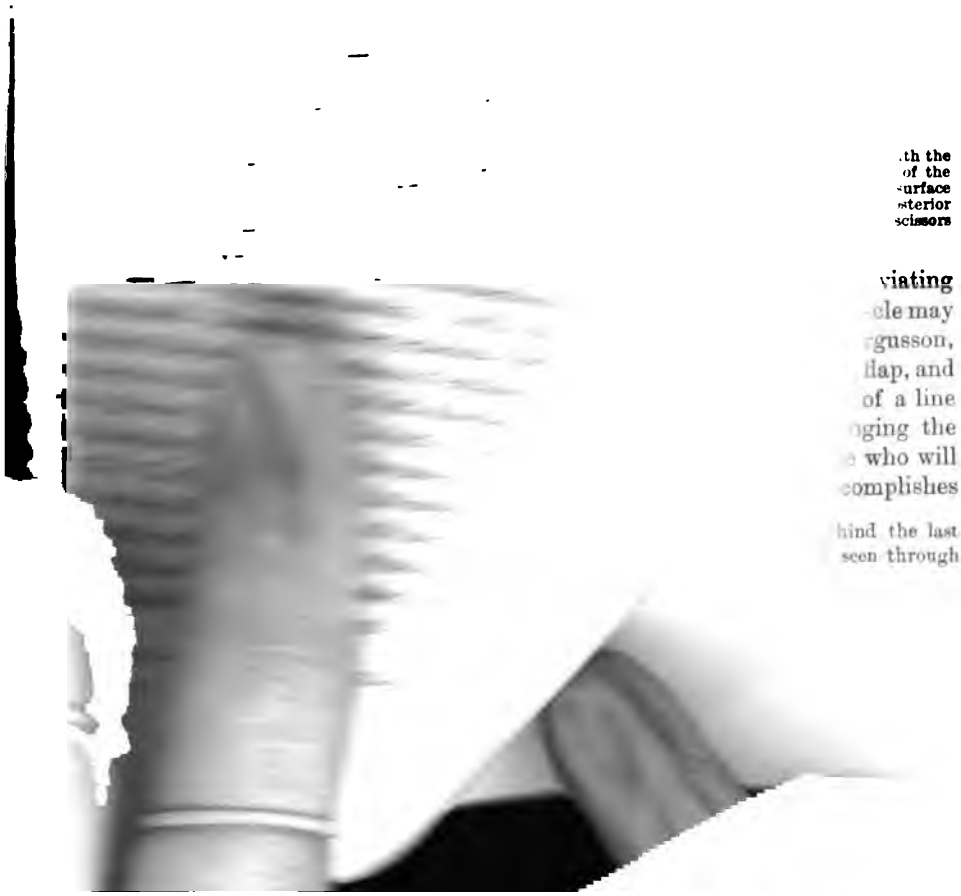
several ways of dealing with this projection. The easiest but also the rudest and least secure method is to break it from the vomer and press it back into the cleft between the two halves of the upper jaw. A better plan is either to make an incision, with a strong pair of scissors, through the septum, or, as recommended by Blandin, to cut out a triangular piece from the septum. This allows the surgeon to press back the intermaxillary portion between the two maxillæ. Bruns recommends that the two parts of the septum nasi be



FIG. 274. Giraldès' operation for harelip.—Holmes's 'Surg. Dis. of Childhood.'

drawn together with sutures; but this recommendation is by no means easy to carry out in practice: and Langenbeck fixes the intermaxillary portion by sutures to the maxillæ. It is very true that the intermaxillary portion, thus replaced, often remains more or less loose, and it is also true that the teeth which it contains are often misplaced, but they can be drawn, and the incisive bone will form a useful support for a tooth-plate when the median tubercle has been thus depressed. The case is then to be dealt with as any other com-

[1] See two figs. Nos. 21 and 25, in my book on 'Surgical Diseases of Childhood.'



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the very earliest periods of life; but there is some little risk in so doing from the bleeding, and there is much greater probability of failure from non-union of the wound, in consequence of some of the numerous disturbances of health

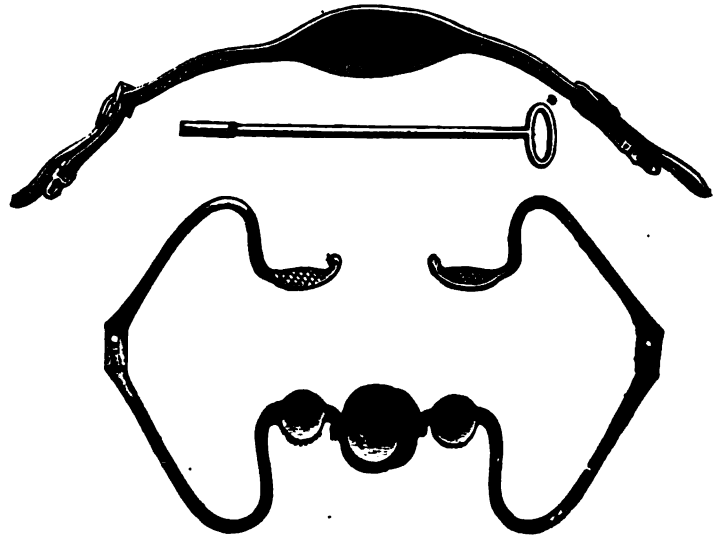


FIG. 276. Smith's gag for staphyloraphy.

Operation for fissured palate, or staphyloraphy.

to which young infants are liable, so that the age of three or four is generally selected. The object of the operation is first to pare the edges of the cleft, then to pass sutures through the flaps, to bring the edges together in their whole extent, and to divide the muscles sufficiently to obviate any traction on the sutures, which are finally to be tied. The patient being fully anæsthetised, the gag here represented is to be introduced closed and then dilated to its full extent, it having, of course, been carefully fitted to the mouth on a previous day. Then the edge of one of the halves of the palate is to be seized with a long pair of clawed forceps, and the whole edge (including the part which has been grasped by the forceps) rapidly removed, and the same on the other side. If the surgeon be completely ambidextrous this is most rapidly done by changing the knife into the left hand, but most operators find it more convenient to cross the hands. Then the sutures are passed rapidly through each flap, each suture being passed double; but the upper ones may be guided through both at once, while the lower suture in the uvula on each side is left double, in order that the surgeon may put the palate on the stretch by drawing on that suture while he divides the muscles. The usual way of passing the sutures is to draw that on one side out of the mouth double—i.e. in a long

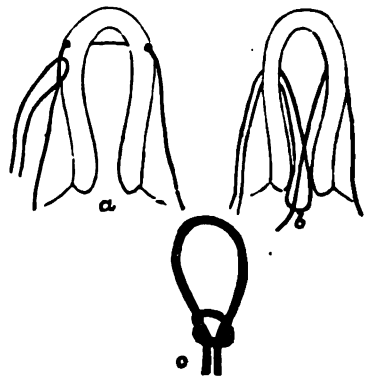


FIG. 277. Method of passing and tying the sutures in fissured palate. *b* shows the single suture passed through the left half of the palate, the double suture through the right, and the end of the single suture passed into the loop of the double one, which is drawn out of the mouth for that purpose. *a* shows the loop drawn back again, carrying the single thread with it, which now lies across the cleft. *c* shows the running knot made by casting a knot on one string and passing the other end through it before it is tightened.

loop—and having drawn the opposite suture out single, to pass its nearer end into the loop of the first, and then draw the looped suture completely out of the mouth. As it comes through it carries the single one with it, which then lies completely across the cleft (Fig. 277). The two ends should then be lightly tied together, so that there may be no risk of the suture being jerked out by any accident. All this having been completed, the surgeon proceeds to divide the muscles by passing a fine knife (that used for paring the edges will answer perfectly) through the palate close inside the hamular process, and drawing its edge as far along the upper surface of the soft palate as may be necessary to paralyse the action of the levator palati (Fig. 278). A very slight acquaintance with the anatomy of the soft palate will suffice to prove the correctness of the opinion expressed by Sir W. Fergusson, that the

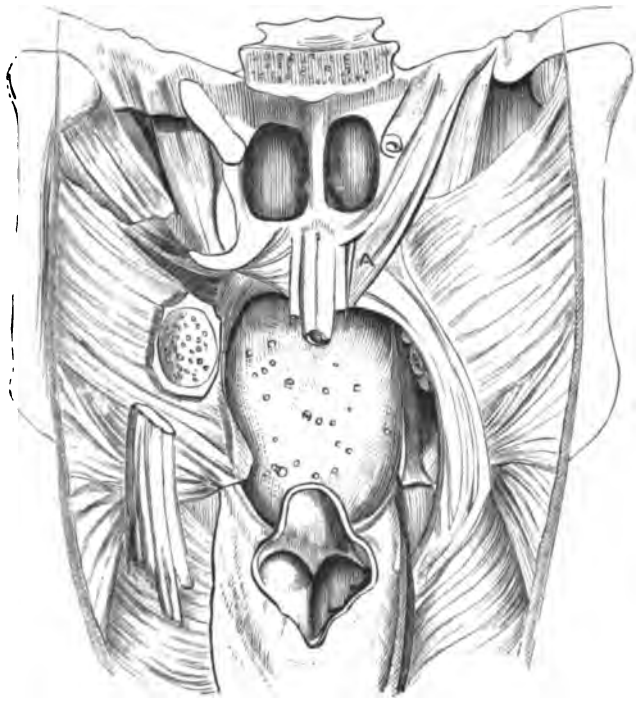


FIG. 278. Dissection of the muscles of the soft palate, showing the levator palati on the right side, with the knife (A) entered close to the hamular process (which is exposed on the other side by the removal of the levator palati. It will be seen that by applying the edge of the knife to the posterior or upper surface of the palate flap almost the whole of the muscle may be divided. The palatopharyngeus or posterior pillar of the fauces is also shown on this side. The muscle can be easily cut across with a pair of scissors if necessary.

division of this muscle is the most effectual and necessary method of obviating any traction on the edges of the wound after staphyloraphy. This muscle may be divided, without fail, by the method recommended by Sir W. Fergusson, viz. to take a rectangular knife, which is to be introduced behind the flap, and with which an incision is to be made perpendicular to the centre of a line joining the hamular process with the Eustachian tube,[1] and prolonging the incision downwards till it reaches the pterygoid process. Anyone who will practise this incision on the dead subject will see that it infallibly accomplishes

[1] The hamular process is always plainly to be felt in the mouth just behind the last molar tooth. In fissured palate the opening of the Eustachian tube will be seen through the cleft.

its object, and Sir William attributes to it the additional advantage that the swelling which follows it pushes the flap downwards and keeps it steady. But it is somewhat difficult to execute on the living subject, and is apt to be followed by a good deal of bleeding. Besides, what makes Mr. Pollock's plan so much more convenient is that it can be put off till all other steps of the operation have been completed. If the operator chooses, the sutures can even be tied before the incisions are made, and this is no small convenience in an operation under anæsthesia. What makes these operations often so troublesome and so exhausting to the patient is the necessity for sponging away the blood, and for allowing the patient to vomit out all blood and bloody fluid which he may have swallowed. The touch of the sponge causes more effusion of fluid; the vomiting fills the mouth with fluid, which has to be sponged away, by which time the patient has probably half-recovered his senses. Then the gag has to be withdrawn and the whole business recommenced. If, on the other hand, the patient is brought completely under the anæsthetic at first, a handy operator can often pare the edges with no great loss of blood, pass the sutures and tie them before consciousness has in any degree returned, and with little or no need of sponging. Then a slight extra dose may be given, and the incisions completed. Mr. Pollock's incision may, in dexterous hands, completely sever the levator, though it appears to me less certain to do this than Sir W. Fergusson's, but this is really of little moment. The knife can be used till the flaps are perfectly flaccid, and no traction exists on the sutures to any extent that can interfere with union, and this is all that is wanted in practice. It is, I think, hardly ever necessary to divide any other muscle, but if the surgeon thinks proper the posterior pillar of the fauces can be cut through to any depth which seems requisite.

The sutures for the soft palate should always be soft. Some surgeons prefer horsehair sutures, which have the recommendation of not requiring removal for a very long time, since they produce very little irritation; but they have the disadvantage of being somewhat brittle (though less so if well soaked) and difficult to tie. Silk sutures answer very well, and can be left in position for five or six days, by which time union is always quite firm, unless any irritation is going on, and if it is the retention of the sutures will be of little use.

After the operation the patient should be well fed on fluid or soft semi-solid food with wine. It used to be thought necessary to prevent him from speaking for some days, but this is impossible with children, and indeed seems unessential.

When the fissure extends only a little way through the hard palate it may be treated like one of the soft palate only. If a small perforation is left it will probably fill up spontaneously or can be filled up afterwards. But if the whole or the greater part of the hard palate is cleft, the mucous membrane and periosteum must be dissected away from the bone, and the muco-periosteal flaps thus made brought down and united in the middle line. In doing this an incision is first made along the line of junction of the nose and mouth, and another parallel to it near the alveolar process, extending backwards into the soft palate as far as seems necessary, and the soft parts raised from the bone with rectangular raspatories. Langenbeck has laid much stress on the advantage of denuding the bones of periosteum in this operation, and is often spoken of as having introduced a new method of operating; but it appears certain to me that his operation differs in no material particular from that which Mr. Avery and Mr. Pollock practised long ago, though he

may have more distinctly laid stress on the fact that the periosteum is (to some degree at any rate) contained in the flap. I say 'to some degree,' for the bone is too irregular in its surface to permit of the periosteum being removed entire. Mr. Pollock[1] has shown that the prospect of success in complete cleft of the palate is in one respect better than in partial cleft, since in complete clefts the edges of the fissure are nearly vertical, while in partial cleft they are more nearly horizontal. The consequence is that when the flaps are pared off the former they meet in the middle line without any tension, while in the latter they are hardly long enough to fill the gap.

It seems good policy, if there is not too much bleeding, to unite the whole cleft at once, as the complete liberation of the whole of the soft parts allows the flaps to come together without any tension, and the lateral incisions will possibly render any division of the muscles superfluous. Many surgeons prefer silver sutures for the hard palate.

When harelip is also present it is well to unite the harelip in early infancy. and this will press the halves together and limit the extent of the cleft; but it is better to defer the more serious operation till four or five years of age.

Shortly before his death Sir W. Fergusson introduced a modification of the operation of staphyloraphy, by osteoplasty. Instead of paring the membrane off the bone he divided the latter with bone-scissors in the line of the incision made near the alveolar process (for which purpose a hole is first to be made through the bone with a sharp chisel), and then the whole moiety of the cleft (bone and all) is displaced to meet its fellow of the opposite side, which is similarly treated. The edges are then pared and the flaps sewn together with stout sutures.

Meningocele and encephalocele.

The other malformations which occur about the head and face are too rare and too little amenable to treatment to render it worth while to discuss them here; but I must refer shortly to meningocele and encephalocele, on account of the interesting questions of diagnosis to which they give rise. They are congenital affections, having the same relation to the cranium and brain which spina bifida has to the spinal column and cord; that is to say, the ossification of the bony case being incomplete, the effusion of fluid—the result of some ill-understood action during fœtal life—forces either the membranes or the nervous substance itself through the unossified part.[2] In the spinal column the nerve-centre is rarely affected. In the brain it is so comparatively often. The fluid collects in the ventricular cavity, and some part of the brain is forced out of the hole in the skull. This is an encephalocele. When the effusion is wholly outside the brain, so that the protrusion is formed only by a bag of the membranes, the tumour is called a meningocele. These protrusions are most common at the proral part of the occipital bone, which in early fœtal life is usually composed of four distinct centres of ossification;[3] and it is between these centres—i.e. just behind the foramen magnum—that the protrusion occurs. Another favourite situation is at the junction of the frontal

[1] 'System of Surgery,' 3rd ed. vol. ii. p. 511.

[2] Such at least is the common opinion, though Sir Prescott Hewett has given strong reasons for doubting it. If the hole in the skull be not the result of arrested development, it must be attributed to pressure by the dropsical brain; but then it is difficult to say why it affects one situation rather than another. Now, the protrusion is as common in the occipital region as in all the other situations put together. See Prescott Hewett, in 'St. George's Hosp. Reports,' vol. vi.

[3] See Gray's 'Anatomy,' 10th ed. p. 23, footnote.

and nasal bones, but any part of the cranium may be the seat of the protrusion, even the base of the skull, and here the effusion is probably in the third ventricle.

The fluid of a meningocele is sometimes completely free in a cyst formed by the dura mater and its arachnoid covering, exactly as in common hydrocele. Such tumours may be completely transparent, and hang over the nape of the neck from a pedicle which reaches up to the occiput. But at other times the fluid is contained in a multilocular tissue, much resembling an enormous overdevelopment of the pia mater,[1] or possibly formed by protrusions from the falces of the dura mater. Very often along with the watery fluid a small portion of the surface of the brain projects beyond the hole in the skull, forming what is called a hydrencephalocele. Pure encephaloceles—i.e protrusions consisting of the brain-substance lying immediately beneath the hernial sac—are rare. They are of small size, and very often produce no symptoms and display little tendency to increase (Hewett, op. cit. p. 188).

Little or nothing can be done for such tumours. Their removal, even when they consist obviously of nothing but water, is too dangerous to be justifiable. Pressure after evacuation of part of the fluid may be tried, and in some cases seems to have done good. Iodine injection has been used (by myself and others), but no success can be claimed. The chief importance of the subject, indeed, is to know the diagnosis of such a tumour, in order to avoid any surgical interference. Such tumours have been mistaken for nævus (degenerated or otherwise), and for sebaceous and other tumours, and many fatal operations have thus been occasioned; while in other cases the patient has been lucky enough to escape with life, even after the removal of a portion of the brain.[2]

The two great points in the diagnosis of these tumours of the brain are the history—showing that the growth is congenital—and the situation in which it forms. But as nævus is always congenital, and sebaceous tumours also sometimes, it is necessary to study very carefully the effects of pressure on the tumour, and to examine the lump most minutely, in order to ascertain the presence or absence of a hole in the skull. In a congenital tumour believed to be a degenerated nævus, or other growth unconnected with the brain, no operation should be ventured upon until the surgeon is completely satisfied that the lump is in no degree reducible, that pressure on it produces no head symptoms, and that its base is free from the bones of the skull.

TUMOURS OF THE CRANIUM.

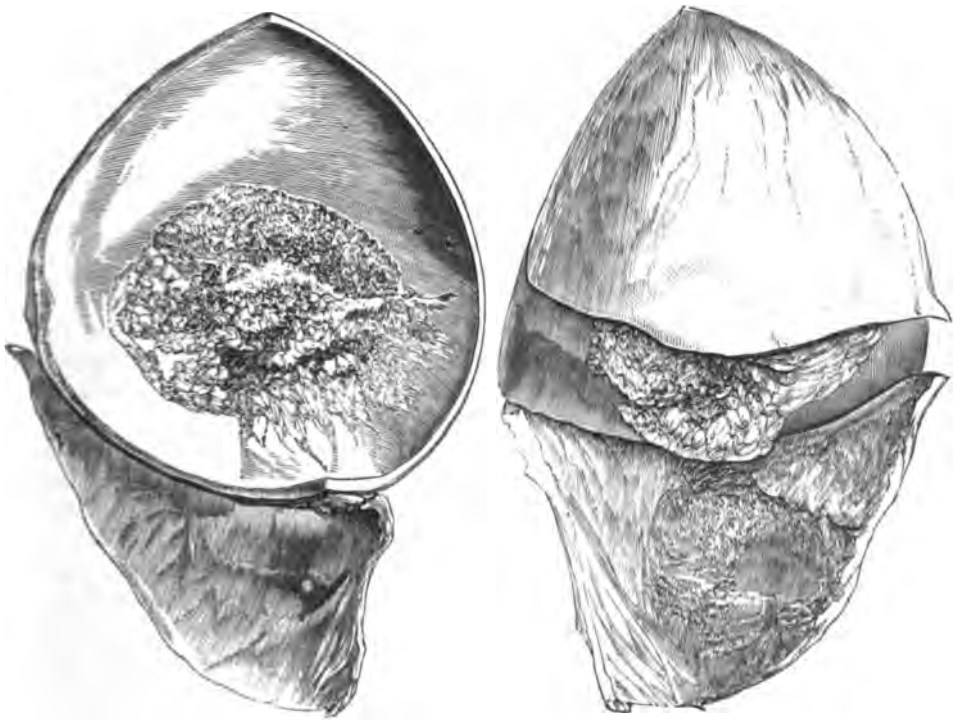
Tumours sometimes arise in after-life which perforate the cranium and lie in direct communication with the membranes of the brain, as in the remarkable instance here figured. These cases were first introduced to the notice of surgeons in Louis's celebrated Memoir on 'Fungous Tumours of the Dura Mater,'[3] where, however, it is clear that several different forms of tumour are confounded together. Some of the swellings there described were very likely (like Mr. Cæsar Hawkins's case) fibrous or fibroid tumours springing from the cranium and growing outwards and inwards. Such tumours are

[1] See Holmes, 'On a Case of Meningocele,' in 'St. George's Hosp. Reports,' vol. i. p. 40.

[2] See Sir P. Hewett's account of an operation by Mr. Tatum. Op. cit. p. 144.

[3] In the 'Memoirs of the Academy of Surgery,' trans. for the Sydenham Society by Drewry Ottley.

distinguished by their slow growth, the imperfect pulsation they receive from the subjacent brain, and the cerebral symptoms which they occasion, and which vary with the state of congestion of the tumour. Others are malignant. These also probably originate in the bone, but they grow much more rapidly, pulsate much more violently (and very probably, in consequence of the presence of large cells in their substance, as other pulsatile cancers in bone do), and destroy life rapidly. I have seen a tumour of this sort mistaken for aneurism by anastomosis, from which, however, the symptoms of pressure



A. Internal view. B. External view.

FIG. 279. 'Fibrous tumour of the dura mater,' taken from a patient who was under Mr. Cæsar Hawkins's care in St. George's Hospital, at intervals, during a great number of years, and who died from an accidental attack of pneumonia, about sixteen years after he had noticed the tumour. The latter had been stationary for many years before death. Its pressure on the brain caused slight epileptic fits and much loss of memory and mental power, but did not affect the general health. Pulsation existed in one or two of the softer parts of the tumour (communicated probably from the brain), and pressure there made him feel faint and oppressed. On post-mortem examination the tumour was found covered by the thickened pericranium, as shown at B. It perforated the skull, and also the dura mater, so that it rested on the surface of the brain. It consisted of a mixture of fibrous tissue with delicate bony spiculæ, covered in almost the whole of its extent by a thin layer of bone. The soft part of the tumour was composed entirely of a mass of spindle-shaped fibres. The brain, though considerably compressed by the tumour, was not otherwise affected.—St. George's Hospital Museum, Ser. xvii. No. 39. Cæsar Hawkins's 'Contributions to Pathology and Surgery,' vol. i. p. 356.

on the brain should have distinguished it. Then there are swellings caused by a hernia of the brain in consequence of disease in the bones of the skull, as in the case related by Mr. Cæsar Hawkins, op. cit. p. 351; and several of Louis' cases seem to have been of this nature. Whether tumours occur which can in strictness be called 'of the dura mater'—i.e. new growths springing from that membrane itself—seems doubtful. The cases altogether are very rare, but are important in respect of diagnosis.

DISEASES OF THE LIPS AND MOUTH.

Herpes.

HERPES on the lip is one of the most familiar of all affections. It is generally held to indicate some slight disorder of digestion, but occurs really in conditions of perfect health. If it requires any treatment at all slight purgation, the regulation of the diet, and mild mercurial ointments are the appropriate measures. A very favourite ointment is gr. x-xv of the grey oxide of mercury to the ounce of lard.

Fissure.

Fissures on the lips are closely allied to herpes, and are sometimes so persistent and so painful as almost to recall the fissures which occur near the anus. But they rarely if ever require incision. The constitutional conditions on which they depend must be ascertained, for it seems certain that they are often a symptom of congenital syphilis, and at other times are dependent on strumous disease. The local application which is most beneficial is the nitrate of silver in stick, with some mild mercurial ointment.

'Strumous lip.'

The upper lip is frequently, and the lower lip less often, the seat of a general enlargement, due to struma, without any special deposit being perceptible. This affection is commonest in young women, and it requires no local treatment, as it will subside under the general treatment indicated for the constitutional disease; but I mention it here, as it excites the patient's alarm, and is to be diagnosed from tumour. The diagnosis is obvious, if the surgeon is acquainted with the affection.

Nævus.

The lips are very commonly the seat of nævus, which in ordinary cases is of the cutaneous or capillary variety, and then requires only the ordinary treatment, in fact, is often stationary, and requires no treatment at all. But in other cases the graver affection called aneurism by anastomosis occurs (more commonly, I believe, on the upper lip), as figured on page 348. The treatment of this disease is often very embarrassing. When it is small the best plan is to cut it out, and bring the halves of the lip together, just as for any other tumour. But when very large it cannot be thus dealt with, and then the red-hot wire introduced and made to cut through the mass—as by the galvanic cautery—is the best method of treatment; or the coronary arteries may be tied by turning the lip out, and the diseased tissue consolidated by the action of setons or electrolysis.

Cancer of the lip.

Cancer is almost uniformly developed in the lower lip, though to this rule there are rare exceptions.[1] It is almost always of the epithelial variety, and often seems to be excited by the irritation of smoking a clay pipe. It is much more common in men than women. It is frequently complicated with enlargement of the submaxillary glands, and is often the seat of considerable pain. It slowly spreads to the tissues of the mouth; but it proves fatal usually by the secondary growth in the neck, and not by any symptoms caused by primary cancer. Its removal is urgently indicated. If the glandular affection, however, be only slight and recent, possibly the enlargement may subside after the removal of the original tumour; at any rate the surgeon is bound to give his patient the chance. The diagnosis is not usually difficult. The warty surface, the surrounding deposit of hard substance, and the persistent nature of the disease sufficiently distinguish it from all other affections, except perhaps chancre. Chancres on the lip are not at all uncom-

Diagnosis from chancre.

[1] Mr. Venning and I related each a case of cancer of the upper lip in the 'St. George's Hospital Reports,' vol. vi.

mon, and, I believe, are often incurred innocently from accidental inoculation of a crack on the lip. In this case the patient can give no history of the origin of the sore, and when the disease arises from lascivious conduct he will give none, so that there is usually no assigned cause to assist in the diagnosis. But the surface of a chancre is less warty and irregular than that of a cancer; the hardness, if there is any (and not unfrequently there is little enough), is uniform, and extends a very little distance beyond the sore, and the bubo is earlier in its appearance than the malignant deposit in the submaxillary glands is. Chancres are equally if not more common in the female sex. Secondary symptoms will generally appear in six weeks or two months and settle the question, or the administration of mercury will speedily cure the sore.

In removing a cancer of the lip, if the disease spreads any distance from the edge, it is best to make a V-shaped incision, running entirely through healthy parts, and sew the two flaps of the lip together with the harelip suture. An assistant stands behind the patient's head and holds the two sides of the lip firmly, so as to prevent bleeding from the coronary arteries. A small stitch may be put in at the red edge of the lip to obviate any break in its line. When, as sometimes happens, the disease appears in the form of a deposit diffused along the border of the lip, but not spreading far into its substance, it is better to shave it off with a pair of curved scissors, and approximate the skin and mucous membrane with a few points of suture.

If a very large part of the lip requires removal the cheek must be liberated by curved incisions running round the alæ of the nose, when the flaps can be brought together, but, of course, with a good deal of tension and a most unpleasant 'underhung' look.

Other tumours, cystic and solid, are found in the substance of the lip, but there are no peculiarities here due to the seat of the tumour.

Ranula is a cyst, very analogous to a ganglion, found in the floor of the mouth and raising up the tongue. It is of a flattened form, something like the body of a frog, and is generally confined to the mouth. Sometimes it grows to a large size, and presents also under the jaw, forming a large swelling, which fluctuates from the neck to the interior of the mouth. It has in rare cases been observed to occur congenitally ('Lond. Med. Record,' 1877, p. 497). Ranula.

Ranulæ are formed sometimes by the obstruction of one of the large salivary ducts, as by a salivary calculus; at other times, as it seems, by the expansion of one of the processes of the sublingual gland, and probably at others by the independent formation of a cyst in the cellular tissue. The fluid contained in the cyst bears the strongest resemblance to that of a ganglion —i.e. it is a clear, yellowish, glutinous fluid, something like isinglass.

The tumour is troublesome from the interference it causes with the motion of the tongue and jaws.

It can in most cases be cured by simply making a free incision into it in the mouth, pressing all the fluid out, and taking care to keep the wound open by passing a director along it daily till the cavity has quite filled up. But it has often seemed to me better to take a piece of the mucous membrane out, by pinching up the wall of the cyst with a pair of clawed forceps and snipping out a piece with the scissors large enough to allow the end of the finger to be passed in. When this is done the cavity can hardly close till it is filled up. But the disease is sometimes obstinate, and then either a seton must be

passed through it or, after free incision, the cavity must be cleaned out and the lining membrane pencilled with nitrate of silver, or, if that is not strong enough, with nitric acid. In some cases of obstinate recurrence it is justifiable to attempt the complete removal of the cyst by dissection.[1]

Those which project into the neck often contain sebaceous matter and are more analogous to sebaceous tumours than ranulæ.[2] But I have seen some whose contents proved them to be true ranulæ. They must be opened by a free incision either in the floor of the mouth or in the middle line below the hyoid bone, which must be kept open till the cavity is obliterated.

Salivary calculus.

Salivary calculi are chiefly seen in connection with ranula. They are small calcareous masses sticking out of and obstructing the orifice of one of the larger ducts—usually Wharton's. They require only a slight incision for their discharge.

Acute tonsillitis, or quinsy.

The tonsils are subject to acute inflammation and abscess from various causes, as in scarlatina, in phagedæna after syphilitic sore-throat, in dissecting wounds, and 'hospital' sore-throat. But the disease especially denominated acute tonsillitis, or quinsy—Cynanche tonsillaris—is an affection allied to common cold, usually attacking persons who are out of health and somewhat predisposed to sore-throat. It often commences with rigors, stiffness, and pain at the back of the throat, and especial pain in swallowing. The whole of the back of the throat is red and swollen, and one side of the soft palate and the corresponding tonsil is especially swollen and red; the tongue is much loaded with a creamy fur, the saliva may run copiously out of the mouth, and in severe cases there is so much difficulty of breathing that the patient thinks himself in danger of suffocation. Gradually the parts around the tonsil soften, the colour of the matter becomes perceptible through the red membrane, and an abscess forms in the substance of the tonsil or in the cellular tissue around. This having burst or being opened, the symptoms rapidly subside. It is rare for both tonsils to be affected at the same time, though not uncommon for one to be attacked after the inflammation in the other has subsided.

The treatment required is almost always somewhat stimulating, for the patient has generally been out of health and the pulse is low. Steaming the throat sometimes gives a good deal of relief; and a mustard emetic at the commencement of the attack is often very beneficial. Gargling is very painful, and does little good. If any local application is advisable a mixture of mineral acid and honey applied with a brush seems best. When the patient suffers grievously from the swelling, yet no pus can be perceived, it is justifiable to make incisions or scarifications into the inflamed tissues, in order, if possible, to relieve the swelling and hasten the approach of pus to the surface; but care must be taken not to direct the point of the knife outwards, especially if the incisions are made at all deeply. If a knife is used its blade should be wrapped in lint to within an inch of the point, the patient's mouth should be widely opened in a good light, and the handle of the knife being directed outwards as it is entered into the tonsil or the parts near it, its point will incline towards the middle line. In this position, even if the patient should start, the large vessels around the tonsil can hardly be injured.[3]

[1] See Michel in 'Gaz. Hebd.' 1877.

[2] Fairlie Clarke, 'Diseases of the Tongue,' p. 217. Pollock, op. cit. p. 524.

[3] Severe and even fatal bleeding has occurred from incisions into the tonsil, possibly in some cases from the internal carotid itself, but certainly in most cases from the enlarged arteries of the gland. In such cases it has sometimes been thought necessary to tie the

Sometimes, after the opening of an abscess in the tonsil, the opening becomes phagedænic, or other acute forms of sore-throat supervene, but this is very rare.

Putrid or sloughing sore-throat and diphtheritic affections are happily now rarely met with, except in epidemics, when they come more under the notice of the physician. I would refer the reader to works on Medicine.

Chronic enlargement of the tonsils is an extremely common affection, generally due to constant irritation from cold and neglect in children of strumous constitutions, but occurring also in those who are well cared for, and not rarely in young women of weak health. As a general rule, when the affection is moderate in extent it is more troublesome than dangerous. But the enlarged tonsils are liable to constant attacks of sore-throat and ulceration; they spoil the voice; sometimes they (or rather the inflamed and thickened condition of the mucous membrane around them) impede the hearing; they prevent sleep except with the mouth open; and when extremely large in early life they may so obstruct the respiration as to produce a partial vacuum within the chest, and thus the pressure on the soft parietes of the thorax may much alter the shape of the chest. Chronic enlargement of tonsils.

Slighter cases may be left with confidence to constitutional treatment; as the health improves the enlargement will subside. But when the swelling is great the removal of the projecting part of the tonsil is urgently indicated, and affords the patient instant relief at the expense of only momentary inconvenience. When the enlarged tonsil projects fairly from the surface this little operation is most quickly performed with the French (or Charrière's) guillotine. This instrument terminates behind in a ring, into which the surgeon's thumb is inserted; at either side is another ring for his fore and middle fingers. The instrument consists of three parts—a base, or lowest stem, which ends in front in a ring, which is to be slipped over the tonsil; above this and travelling in it in a groove is another stem which ends in a ring, and the edge of this ring is sharp, so that as it is pushed forward it cuts off the part of the tonsil over which the instrument has been slipped; and above this again, also travelling in a groove on the base of the instrument, is a stalk, ending in the thumb-ring behind and in a double hook in front, and so jointed on to the base that as it is pushed forwards it rises away from the stem. In using this guillotine the surgeon sees first that it travels freely; then he draws all its parts well home, passes it into the mouth, where it serves as a spatula, gets the ring fairly round the tonsil, then by pushing his thumb forwards digs the double hook into the tonsil, and as he pushes his thumb on as far as it will go the double hook rising away from the stem draws the tonsil still further into the grasp of the ring, and the knife-blade shaves it off. The whole affair is momentary, and the pain very slight.

But when the tonsil is flatter and more irregular in shape it is better to seize it with a vulsellum, and cut it off with a curved blunt-pointed bistoury, directed from above, upwards and inwards, the blade being guarded with lint to within half an inch of its end.

Children, and other nervous persons, who cannot be persuaded to open

common or external carotid. But usually the bleeding may be stopped by firmly pressing a compress of lint steeped in perchloride of iron on the bleeding spot for some time. If the patient is too nervous or distressed to tolerate this without anæsthesia, ether or chloroform may be administered; and then, the mouth being held open with a gag in a good light, the bleeding spot will be well under command.

the mouth, may be narcotised, the mouth being kept open by Smith's gag (page 582).

There is not much bleeding after the removal of the tonsil, unless the surgeon has been more anxious to remove the whole mass than is at all necessary. All that is really required is to cut the surface off freely. The swelling is produced by obstruction of the orifices of the gland-ducts leading to a retention of epithelial secretion within them, which dilates the follicles and gives rise to inflammatory exudation into the cellular tissue. When the follicles have been freely cut across all this will subside.

Cancer of the tonsil.

The tonsil is sometimes, though not very often, the seat of primary cancer.[1] The cancer generally grows rapidly, and the patient's life seldom lasts more than about a year. The diagnosis, in the cases which I have seen, was obvious. No special treatment was employed, nor do I think that any operation is desirable. Attempts have been made by Mr. Bryant and others to remove the tumour from the mouth by means of an *écraseur*, but obviously this operation can hardly be efficient. Dr. Cheever of Boston[2] has twice removed the mass by external incision and a complicated operation in which the lower jaw was divided, but in both cases the disease soon recurred, and according to his own conviction the operation is one of very doubtful expediency.

Dr. Eliot records in the 'Am. Journ. of Med. Sci.' July, 1879, a case in which a sarcomatous tumour of the tonsil was removed, with at any rate temporary success. The rate of the growth, its diffusion into neighbouring tissues, and its accessibility would decide the propriety of the attempt.

Relaxed uvula.

Relaxation of the uvula is an affection very trifling in itself, but it produces distressing symptoms, such as constant cough and frequent vomiting, which when the cause is overlooked often needlessly alarm the patient. In many cases the relaxation is habitual, recurring on any trifling cold or disturbance of health. Painting with an astringent lotion (as glycerate of tannin or nitrate of silver), with purges and tonics, is sufficient in such cases. When the elongation is considerable and inveterate, the uvula should be taken hold of with clawed forceps and snipped off.

Alveolar abscess.

'Alveolar abscess may be defined,' says Mr. Salter, 'as a suppuration around the fang or fangs of a tooth, usually carious, accompanied by absorption and expansion of the bony walls of the alveolus or alveoli, and the enlargement of the little pus-sac, the matter gradually finding its way to the surface either along a canal by the side of the fang of the tooth, opening at the edge of the gum, or through the gum itself at a point corresponding to the root or roots of the tooth implicated. When, however, the fangs are unusually long, or the reflection of the mucous membrane from the gum to the cheek or lip is very superficial, this same discharge may burrow still more outwardly and find its exit upon the surface of the face.' Mr. Salter, however, points out that the extension of an alveolar abscess to the external integument is limited in the upper jaw to those which are connected with the back teeth. Where the central teeth give rise to abscess which extends to a distance it burrows along the hard palate, and the lateral incisor is the usual source of this suppuration. In the milk-teeth it is rare for alveolar abscess to extend to a distance.

[1] I speak of these rapidly-growing and fatal tumours as 'cancer,' but anatomically they are often if not usually sarcomatous—though they rapidly implicate the absorbent glands.

[2] 'Boston Medical and Surgical Journal,' Aug. 1, 1878. It appears from this article that the operation has also been twice performed in Germany, by Langenbeck and Hüeter. Neither case was published, and the operation seems to have been given up.

The common alveolar abscess, or gumboil, which points above the gum, either on its outer or inner side, is easily recognised and generally easily treated. If the tooth is so far diseased as to render its removal desirable, this is, of course, a radical cure. If the irritation is connected with stopping, the stopping should be removed; and if the tooth is to be preserved, free leeching and fomentation of the gum, combined with purgatives, will sometimes avert suppuration; but when matter has formed it should be early evacuated.

The difficult cases are those in which matter, having its origin in caries and suppuration around a tooth-fang, burrows to a considerable distance and appears as a sinus, usually with a protruding granulation, at a distant part of the face or under the chin. Such cases are constantly mistaken for cases of disease of the jawbone, though an attentive examination will show that there is no exposed surface in the jaw, and that there is a carious tooth surrounded by thickened and inflamed tissues. Such cases are aptly compared by Mr. Salter to cases of necrosis, the diseased tooth being, in fact, a sequestrum; and their treatment must be precisely the same, viz. the removal of the tooth, in doing which great care must be taken to see that it comes away entire, or if not that every fragment is afterwards removed.

Necrosis of the jaws.

Necrosis attacks the jaws from various causes. In strumous disease, along with the caries of the teeth, to which strumous patients are so liable, portions of the jaw not unfrequently perish, and becoming exposed in the mouth, give rise to a fœtid discharge which poisons the breath, and in some cases is a source of real danger, from the cachexia which it induces. Necrosis, especially of the lower jaw, often follows fracture. But there is nothing peculiar in the pathology or treatment of such cases, except that the surgeon will be more anxious than in other regions of the body to extract the sequestrum early, in order to free the patient from the putrid odour which it causes.

Phosphorus necrosis.

There is, however, a peculiar form of disease which affects the jaws, caused by the local action of the poison of phosphorus in persons who are exposed to the fumes of that mineral in lucifer-match manufactories. It has been abundantly proved that the disease is only generated in those who have carious teeth, and that it is caused by the acid fumes of the phosphorus (i.e. either phosphorus or phosphoric acid) dissolved in the saliva, and so applied directly to the exposed alveolar process. The disease, therefore, might be prevented by seeing that all the workpeople had healthy teeth, and by the use of a mask in which the acid fumes would be stopped by passing the air through a sponge or some fabric saturated with a solution of one of the fixed alkalies or their carbonates. But the use of the amphorous phosphorus, which does not give off any such deleterious fumes, and which is now largely used to form the coating of the box on which the match ignites, has tended more than any such precautions to diminish the prevalence of the disease, which is accordingly now much more rare than it was some years since. The same consideration renders it inexpedient to devote much space to this subject.[1] The advent of the disease is marked by much suffering, and occasionally by considerable bronchial irritation produced by the fumes. The diseased periosteum swells up, and an enormous mass of spongy bone surrounds the sequestrum, especially in the lower jaw. The dead bone often takes long to separate, even after the teeth have come away, and when it is removed an enormous mass of bone is left to

[1] I would refer the reader to Dr. Bristowe's report, 'On the Manufactories in which Phosphorus is Produced or Employed;' 'Fifth Report of Med. Off. of Privy Council,' 1863; and to Mr. Salter's article in the 'Syst. of Surgery.'

replace it. In some cases this new bone remains, and performs all the functions of its normal predecessor. Even when the whole lower jaw and both condyles have come away, the reproduced bone has been both useful and moveable, being doubtless attached by ligament to the skull. In other cases the reproduced jaw, though exuberant at first, has withered away and left only a thin scar-like band, so that the patient has been permanently deformed.

The main indications of treatment are, first, to place the patient in a pure atmosphere and support the strength; next, during the process of separation to hasten it as far as may be, and liberate tension by as free incisions through the thickened periosteum as may seem prudent; then to remove the sequestrum at the earliest possible moment; and, finally, as Mr. Salter suggests, to adapt teeth to the reproduced bone, and endeavour by providing it with a function to avert the consecutive atrophy to which it is sometimes exposed.

Exanthematous jaw-necrosis.

Mr. Salter also likens to this phosphorus-disease the necrosis of the alveolar process which sometimes occurs after scarlet fever and other exanthemata, and which he believes to be produced, as that is, by the application of the morbid poison to the jaw exposed by the presence of carious teeth. The gums, he believes, are affected in these cases in the same way as the skin is by the fever-poison; and thus, if the bone is exposed by caries of the teeth, the periosteum may become implicated. The question is one of much pathological interest, but its surgical bearings are the same as those of any other form of necrosis.

Tooth-tumours.

Tooth-tumours, or 'odontomes,' are divided by Mr. Salter into (1) enamel nodules, or submerged cusps on tooth-fangs, which form small pearly tumours consisting of a thick tubercle of enamel, covered by enamel-pulp. These are of no surgical importance, and occasion no symptoms. (2) Exostoses, or over-development of the crusta petrosa, which sometimes attains a size that requires removal; and this affection may attack one tooth after another, according to Mr. Salter, causing pain which will persist till all the teeth in one or both jaws have been extracted. (3) Hypertrophy, or dilatation of the fangs, which then differ only physiologically from exostoses. The symptoms they cause are the same, and they equally demand extraction. (4) Dentine excrescences growing from the dentine into the pulp-cavity, and producing constant and severe neuralgia, which requires the extraction of the teeth. The disease cannot be recognised till after removal. (5) Warty teeth, the 'dentinal odontomes' of Broca, in which one or more teeth are affected by a large lobed warty tumour growing from some part of the tooth either into the mouth or into the substance of the jawbone, and composed of a confused mass of bony structure and dental tissues. The chief importance of a knowledge of these tumours is to avoid the removal of the bone in such cases, for the simple extraction of the tooth along with the tumour will be sufficient; but if the growth has been allowed to attain extraordinary size the diagnosis may be difficult.

Finally, it will suffice just to mention the polypous tumours which grow from the tooth-pulp, either in caries or after the fracture of a healthy tooth. The chief surgical importance of the latter subject is that such fracture of a tooth is common in fractured jaw, and that the growth of this polypous tumour from the pulp, which is acutely sensitive, may prove a most troublesome complication, unless it is detected and the tooth removed.

TUMOURS OF THE JAWS.

Tumours of the jaws.

Tumours of the jaws are best described as cystic and solid, innocent and malignant.

Cysts.

The true cystic tumours in the bone are more common in the lower than the upper jaw, and those are often, if not always, the consequence of irritation around the sac of a tooth which has been misplaced or ill-developed. In many cases the connection is rendered obvious by the fact that the wall of the tumour contains one or more teeth more or less imperfect and more or less misplaced, and to these tumours the name of 'Dentigerous Cyst' is properly applied; but in other cases the connection between the cyst and the teeth can only be a matter of inference. The misplaced tooth has always been one of the second set, except in a single instance recorded by Mr. Salter, where a similar tumour formed around a tooth said to be a milk molar. Small cysts are also found in connection with the fangs of perfect teeth.[1] The diagnosis of dentigerous from other cysts of the jaw can be made approximately by observing the absence of the tooth, and absolutely by incision into the cyst, when the tooth will be found and should be removed. This will generally be followed by the filling up of the cavity. In other cases multilocular cysts have been found, i.e. tumours in which the main cavity has been divided by septa into two or more secondary spaces, and others which would be more correctly described as a congeries of small independent cysts. Finally, there are cases of cystic sarcoma or carcinoma —i.e. cases in which a large cyst is formed in the substance of a tumour which is itself more or less malignant.

Cysts of the antrum.

The subject of cysts of the antrum and dilatation of that cavity is so closely connected with that of cystic tumours of the jaw, that although such cases hardly come logically under the designation of tumours of the jaw—and some, in fact, are hardly to be styled tumours at all—I must treat of them in this place.

Most of these cases of dilatation of the antrum appear to be due to the development of cysts in the substance of the lining membrane, as was long ago pointed out by Mr. W. Adams and M. Giraldès,[2] the cyst being formed by the dilatation of one of the crypts of the mucous membrane. In some cases such cysts are very numerous, and then do not generally increase much, but in others they are single, and their constant increase may lead to the suspicion of a tumour of the jaw, and even (in one lamentable case referred to by Mr. Heath) has occasioned the total removal of the jaw. Usually, however, they are easily distinguishable from cancer or any other solid tumour, and they are spoken of as dropsy of the antrum, and used to be regarded, before the publication of Mr. Adams's and M. Giraldès' researches, as uniformly due to inflammatory distension of the entire cavity, sometimes followed by suppuration or abscess of the antrum. And it seems certain that such general irritation followed by abscess does exist in some cases, being in all probability caused by morbid action around the fangs of the bicuspid, canine, or first molar tooth, which are in close proximity to the lining of the antrum.[3] The symptoms, then, of a large cyst developed

Dropsy and abscess of the antrum.

[1] See Heath, 'On Diseases and Injuries of the Jaws,' 2nd ed. p. 160.

[2] Heath, op. cit. p. 156.

[3] On the Anatomy of the Antrum, see Salter, in 'Syst. of Surg.' 3rd ed. vol. ii. p. 465.

in the antrum are identical with those of dropsy of the antrum, that is to say, general distension of the upper jaw below the orbit, with some aching pain, and a sensation of yielding or perhaps positive crackling on pressure above the alveoli; sometimes also purulent or other fluid exudes into the mouth on pressure, and in cases of abscess the distinctive symptoms of suppuration may have been noted.[1]

The treatment of cysts and that of dropsy of the antrum is at first the same, namely to make a dependent opening, by drawing one or more teeth if they are carious or loose; or, if the teeth are sound, but the bone much thinned above the alveoli, to make a tolerably free incision through the wall of the antrum in that position, and then to keep the cavity syringed out with some disinfectant, of which perhaps Condy's fluid diluted is the best. Simple dropsy and abscess will yield to this treatment; but if the enlargement is due to a cyst it may be necessary to enlarge the opening sufficiently to scrape out all the tissue connected with the cyst or cysts. The total removal of the upper jaw can never be required.

Cystic tumours of the jaws.

The other cysts in the lower or upper jaw require free incision, the removal of any misplaced teeth which may be found in their interior, and the approximation of their walls by well-adapted pressure of pad and bandage. The opening into the tumour must always be kept perfectly free, and stimulating injections are thought sometimes to hasten the closure of the cyst. Removal of the jaw has been practised in these cases,[2] and it might perhaps become necessary if the simpler operation failed to give effectual relief; but it is generally unjustifiable. A sufficiently free opening can almost always be obtained in these cases from the interior of the mouth.

I ought to add that care must be exercised in the case of any supposed solid tumour of the jaw, which is at all elastic, to make sure that it is not of the cystic variety, for many cases are on record in which, after extirpation of the jaw, the surgeon has been shocked to find that he was dealing with a simple cyst with somewhat thick walls, and therefore that the patient could have been cured without any mutilation. The condition of the teeth also should be carefully studied. And finally, the opposite mistake should be avoided, of taking for a simple cyst that which is only a cystic formation in a solid tumour. The majority of such cyst-bearing tumours will be malignant clinically, though perhaps anatomically to be reckoned among the sarcomata.

The solid tumours of the jaws may be divided into the innocent and the malignant.

The innocent tumours will be subdivided into fibrous or fibroid, cartilaginous and osseous.

Epulis.

The most familiar of the fibroid growths are called epulis, from their position just above the gums. These are either purely fibrous or fibro-cellular, or, as is frequently the case, mixed with myeloid elements. The first class are unquestionably innocent; the two latter, like the other sarcomata, are of a more suspicious character—i.e. they may recur locally—but they are hardly of a truly malignant or cancerous nature. To this rule I have, however, seen two exceptions in which epithelioma occurred in the situation of an epulis. Epulis has its root just above the teeth, and frequently from the lining mem-

[1] In very rare cases (three are referred to by Mr. Salter, op. cit. p. 466) abscess of the antrum has caused amaurosis, the sight returning on the relief of the abscess.

[2] As in a celebrated case operated on by Sir B. Brodie, and figured in 'Syst. of Surg.' vol. ii. p. 528, 3rd ed.

brane of one of the alveoli; at other times it makes its appearance at some distance from the alveolus, usually on the exterior, in rarer cases in the cavity of the mouth; but in these cases also Mr. Salter [1] suspects that the tumour is connected primarily with the periodontal membrane; and even in cases where an epulis forms on a jaw apparently edentulous it will be found, according to Mr. Salter, that some fangs of teeth have been left behind. Epulis is more common in the upper than in the lower jaw, the proportion being fixed by the same author at about two to one.

The treatment of epulis consists in its removal, along with the tissue from which it springs, i.e. the periodontal membrane, or the lining of the alveoli. Very often the growth of the epulis has completely displaced the teeth, and in such cases all that will be necessary is to cut the tumour freely away from its base and rasp the latter away from the subjacent bone with a strong knife. This will cut away all the alveolar tissue, and the periodontal membrane, if any is left, will atrophy, and so the whole tissue from which the tumour springs will ultimately have been removed, and then no recurrence need be feared. If the teeth have been left at the first operation and recurrence takes place, which is tolerably often the case, the surgeon must be careful to remove them at the second, and the cure will probably then prove permanent. But in inveterate cases, after the removal of the teeth, it is necessary to clip away the bone to some extent with curved cutting forceps, so as to make sure of having removed the whole of the alveolar portion of the jaw; and if any doubt exists on this point, or if suspicious-looking granulations sprout from the wound, some strong caustic (of which the pure nitric acid is the best) must be unsparingly employed. Under such treatment a definite cure may be confidently promised.

Fibrous tumour of body of bone.

Fibrous and cartilaginous or fibro-cartilaginous tumours also spring from the body of the bone unconnected with the teeth. The antrum is the favourite seat of the purely fibrous tumours, and here they often extend widely in all directions. But it must be recollected that in many of these cases, as in Sir P. Hewett's case [2] (quoted by Mr. Pollock, 'Syst. of Surg.' 3rd edit. vol. ii. p. 531), the growth which has been taken for a tumour of the antrum really springs from the base of the skull, a point which will be hereafter again alluded to. Fibrous tumours are also found springing from the interior of the skull and expanding the bone around them. In one curious case, referred to by Mr. Pollock, in the Museum of St. George's Hospital, there is a nucleus of bone in the centre of the tumour; and in another, which Mr. Heath describes, in the College of Surgeons' Museum, the tumour is calcifying like a uterine fibroid.

The diagnosis of these fibrous tumours from others which are of a softer consistence and of a more malignant character rests on their slow growth, their regular rounded outline, especially in the lower jaw,[3] and their firm, uniform consistence. They may bleed to a certain extent [4] from the constant irritation to which they are subject.

When a truly fibrous tumour is entirely removed along with all the bone from which it springs, it will not recur. The numerous instances on record of recurrence after operations of this nature have depended, no doubt, on the fact

[1] 'Syst. of Surg.' 3rd ed. vol. ii. p. 455.

[2] 'Med.-Chir. Trans.' vol. xxxiv. p. 43.

[3] The fibrous tumours of the antrum consist of a great number of large lobes which pass into all the spaces communicating with that cavity.

[4] Pollock, op. cit. p. 532.

that the tumour was not purely fibrous, but sarcomatous in part; or in some other cases on imperfect removal. In operating on a fibrous tumour, therefore, it is desirable to cut wide of the tumour, and, whenever it is possible, to remove the whole of that part of the bone from which the tumour springs.

Enchondroma.

Cartilaginous tumours are rare, but they sometimes attain an immense size. Mr. O'Shaughnessy removed a fibrous enchondroma from the upper jaw which was nearly as large as the patient's head, and overlapping the lower jaw, which was contained in a groove on the lower surface of the tumour. (Heath, p. 243.) In the Museum of St. George's Hospital is an enormous mass of enchondroma (Ser. xvii. No. 66),[1] which implicates the upper jaw, but is chiefly connected with the base of the skull. A few other cases of a similar nature are recorded, and one was operated on by Mr. Morgan, of Guy's Hospital, with some success. Mr. Moore, however, in an attempt to remove such a growth found the disease to be myxomatous, and the patient died on the table.

Exostosis.

Exostosis of the jaws is often of the ivory variety, as in the cases figured on pp. 437, 438—the former from the lower, the latter from the upper jaw. For the main considerations relative to their treatment I would refer the reader to that place.

Malignant tumours.

The malignant forms of solid tumour in the jaws are sarcomata and carcinomata; the former are often mixed with cysts, the solid matter being usually of the round or spindle-celled variety, sometimes myxomatous. Myeloid tumours are more common in the form of epulis than as diseases of the body of the bone, and are usually innocent, though to both rules there are many exceptions. Cancerous tumours are usually, if not always, of the medullary variety.

These forms of tumour of course demand complete and free removal, if seen early enough; but the prognosis is highly unfavourable. In all cases that I have had the opportunity of watching recurrence has taken place very early.

It appears probable, from cases recorded by Mr. Wagstaffe and Mr. Heath,[2] that in some of these cases of cystic sarcoma the disease 'commences in the mucous or submucous glands of the gum and cheek, and only subsequently invades the jaw.' Mr. Heath refers to a case under Mr. Skey's care in which the outer wall of both the upper and lower jaws was involved. The disease was freely cut away, and the patient made a good recovery.

Tumours of the antrum.

Any of these forms of tumour may originate in the antrum of Highmore. Some tumours of the antrum are purely fibrous, others, no doubt, glandular, or adenomatous—i.e. morbid imitations of the glandular tissue of the mucous membrane lining the antrum. I have already referred to the existence of exostosis in the antrum, and the occurrence of malignant tumour is unluckily only too common.

The diagnostic sign of a tumour having its origin in the antrum is that it expands the wall of that cavity in various directions, so as to invade several of the spaces with which the antrum is in relation. It presses laterally into the nostril, downwards into the mouth, upwards into the orbit, backwards into the pharynx or pterygomaxillary fossa, and outwards into the zygomatic and temporal fossæ and very commonly in many or all these directions at once. A tumour, however, growing from the base of the skull may so envelop the upper jaw as to grow in several of these directions, as exemplified

[1] See also 'Path. Trans.' vol. x. for a description of this case, with a drawing.

[2] Wagstaffe, 'Path. Trans.' vol. xxii.; Heath, op. cit. p. 303.

by Sir P. Hewett's case above mentioned, so that the diagnosis should not be arrived at without careful examination.

The origin of a tumour from the antrum is a matter of importance, because then the surgeon may be confident of removing the whole of its attachment. The complete excision of the upper jaw removes every part of the antrum, and is therefore much more satisfactory than operations on tumours of the base of the skull can ever be.

Operations on the jaws.

The upper jaw may be removed either partially or entirely. In the partial removal the orbital plate is left behind, while in the other operation not only the entire maxilla, but, if it is wished, the malar bone also may be excised. The plan formerly in use was to make two incisions, one somewhat vertical from the inner angle of the orbit, coasting round the nose, and dividing the lip in the middle line to its free edge; the other sloping down from the malar prominence (or from the zygoma if the whole malar bone also is to be removed) to the outer angle of the mouth. But these extensive incisions are rarely necessary. A single cut running under the lower border of the orbit, and embracing more or less of the extent of that cavity as may be thought necessary, and extending from thence along the outer side of the nose through the lower lip, enables the operator to turn back as large a flap of the cheek as is ordinarily necessary; one or two of the front teeth should be drawn at the commencement of the operation. If the facial or any large artery has been divided it is to be tied. Then the two upper jawbones are separated from each other by a cut with the saw or bone-nippers along the hard palate, the ascending process of the superior maxillary bone is cut across, and the malar divided from the superior maxillary by notching it with the saw and then completing the division with the forceps. Now, on twisting the bone with the lion-forceps it will become loose, and is to be severed from the soft palate and its remaining attachments with the knife. In doing this the internal maxillary artery is sometimes divided, but as there is now a large and free opening there will be no difficulty in securing it. The large gap is to be filled with a piece of dry lint, and the soft parts united with numerous sutures and a hare-lip pin or two. Recovery is generally rapid. A large gap will be left in the mouth, which must be filled up with an obturator.

Partial removal of upper jaw.

If only the body of the bone is to be removed, the orbital plate being left, after severing the ascending process of the superior maxillary bone, the cut is to be extended outwards, with a keyhole saw or cutting forceps, beneath the orbit, until the whole of the wall of the antrum has been separated from its roof, and then the loosened bone is to be twisted out with the lion-forceps. This operation is used chiefly to obtain access to the base of the skull in the case of fibrous nasopharyngeal polypus. The end is attained with less deformity than if the entire bone be removed.

Langenbeck's osteoplastic resection of upper jaw.

Finally, Langenbeck has devised an operation in these cases which he denominates 'the osteoplastic resection of the upper jaw.' Instead of removing the soft parts from the jaw, 'the requisite incisions are made down to the bone at once, the bone is sawn through in the same incisions, and the portion thus forcibly detached turned inwards, without otherwise dividing it from its connection with the nasal and frontal bone. The tumour is then removed from behind the bone, and the latter replaced in its original position. No incision is made at the place where this bending or fracture must necessarily occur.'—Pollock.

I must refer the reader to the original ('Deutsche Klinik,' 1859 and 1861) for details as to this plan of treatment. It has not commended itself to

surgeons in this country, nor do I believe that it is now in much use anywhere.

Removal of lower jaw.

Operations on the lower jaw may be conducted entirely inside the mouth, if only a portion of its thickness is to be removed; but when any part of the whole depth of the bone is to be taken away an external incision will be required.

The whole of one side of the lower jaw may be removed by making an incision through the middle line of the lower lip and along the lower border of the jaw to the situation of the articulation, denuding the anterior surface of the bone and tying the arteries, sawing through the bone in the middle line, cutting the muscles and mucous membrane away from its inner surface, then seizing the bone with the lion-forceps and twisting it out, so as to dislocate it from the skull, any remains of the ligaments being touched with the knife, which is kept very close to the bone in order to avoid the external carotid artery. In this, as in all other extensive operations on the lower jaw, the tongue should be commanded by a stout ligature passed through it before the operation is begun, otherwise the patient may be in danger of suffocation from its falling back over the entrance to the larynx. If it is necessary to remove the whole jaw, the same operation may be repeated on both sides, or the incision through the middle line of the lip may be dispensed with, the whole of the lower lip and lower part of the face being turned off the bone by a free incision from one side to the other, after which the bone is divided in the centre and its two halves dissected out as before.

Anæsthesia in operations on the jaws.

In all operations on the upper and lower jaw which involve extensive incisions and therefore danger of formidable hæmorrhage, the surgeon must remember that anæsthesia involves a certain amount of danger. I have, it is true, removed the whole upper jaw frequently under anæsthesia, without any bad symptoms, and have seen the operation so performed by many other surgeons; yet the reality of the danger is testified by Sir Prescott Hewett's well-known case,[1] and another which occurred not very long since at St. George's Hospital, in both of which death was attributed, with at any rate much probability, to the entrance of blood into the air-passages while the patient was unconscious. So strongly do some surgeons feel the danger of anæsthesia in such cases that they prefer to perform tracheotomy as a prelude to removal of either jaw under anæsthesia. This is not, I think, absolutely necessary, but in any case where the patient has the necessary resolution I much prefer to perform the operation without an anæsthetic; and I have met with three cases under the care of Mr. Tatum, Mr. Haward and myself, in which the patient has had the operation performed sitting in a chair without making any complaint, or embarrassing the operator in any way.[2]

Closure of the jaws.

Finally, I must say a few words about that very troublesome affection which consists in permanent closure of the jaws. In rarer cases this is caused by ankylosis of the temporomaxillary joint, but more commonly by the destruction of the mucous lining of the mouth by sloughing from cancrum oris or mercurial poisoning, by phagedænic or by lupoid ulceration, and the substitution for it of a cicatricial tissue, which will go on for years contracting more and more tightly, and in which bone is sometimes developed. In the slighter cases of this cicatricial contraction, as in other cicatrices, it may be possible to stretch the cicatrix and keep it stretched by mechanical means,

[1] 'Med.-Chir. Trans.' vol. xxxiv. p. 43.

[2] In my case (referred to on p. 610) the operation was repeated again without any anæsthetic.

just as is done in contractions of burns. But when the contraction is formidable I have never seen this plan successful. Two operations have been proposed for the partial relief of the painful consequences of this infirmity, by establishing a false joint in the lower jaw. One (Rizzoli's) consists in dividing the jaw from within the mouth with a fine saw, and preventing the union of its segments either by constant motion or by inserting a piece of guttapercha between them. This, however, is now rarely practised, being apparently less efficient than Esmarch's plan of dividing the jaw by an external incision in front of the cicatrised part and taking a wedge-shaped piece out of it. This operation, if practised fairly in front of the cicatrix, is said by Mr. Heath to yield good and permanent results. Or attempts may be made to divide the tissues between the bones, and screw the bones apart by instruments applied between silver shields moulded to the upper and lower jaw.

In contraction from ankylosis the ramus of the jaw should be divided with a fine saw as near the joint as is found practicable, and a small piece removed. This can be effected without external incisions.

I must refer the reader to Mr. Heath's work for a full description and discussion of these rare and somewhat unsatisfactory cases.

DISEASES OF THE NOSE.

THE diseases of the nose are divided naturally into those of the external parts—the skin and cellular tissue; and those of the interior—the bones, cartilages, and mucous membrane.

Disease of the external parts.

The commonest affection of the external parts of the nose is that to which the name of Acne rosacea is generally applied, though the name may not be an exactly appropriate one, true acne being considered to be in all cases an affection of the sebaceous follicles; while in acne rosacea, though the sebaceous follicles may in many cases be affected, in others they certainly are not. The disease in its simple form consists in an injection of the capillaries of the skin, which produces a red, shiny, greasy appearance, in some cases limited to the tip, at others extending over the whole of the organ. The sebaceous follicles may be also affected, and in those cases the skin is marbled and irregularly knobbed. The simple form of acne is more common in women than in men, and is generally developed about the cessation of menstruation, with which function it seems to have some unexplained connection. In the male sex it may be referred to disorders of digestion, exposure to the weather, or other sources of ill-health, but seems to have no necessary connection with intemperance. The 'acne hypertrophica,' 'spirit-drinker's nose,' vulgarly 'grog-blossoms,' is a severer form of the same complaint, due to the abuse of wine or alcohol, in which the sebaceous glands are always much affected, and which is followed by enormous hypertrophy, producing the pendulous masses called lipoma, which are so familiar in old topers.

Acne rosacea.

Lipoma nasi.

In all cases of acne the first care of the surgeon is to ascertain if possible whether any inordinate indulgence in the pleasures of the table has given rise to the disease, or whether it is connected with any obstruction to the menstrual discharge, and to counteract such deleterious agencies by gradual and judicious treatment. Local applications are numerous, and are chiefly of the stimulating kind. Hot bathing of the part, followed by the application of a lotion of the perchloride of mercury, one or two grains to the ounce, is said by

Mr. Durham to be efficacious in the milder cases. Soaps of carbolic acid or some salt of sulphur, or pastes of these substances laid on the parts overnight and washed off in the morning, or ointment of iodide of sulphur, may be tried in more advanced cases. In obstinate cases Hebra recommends longitudinal incisions to be made through the hypertrophied parts, and after the bleeding has somewhat ceased the surface of the incisions to be brushed over with liq. hyd. perchloridi. But when the pendulous masses called lipomata [1] are developed, nothing short of their extirpation will do any good, and the operation is often quite successful, though in patients of this kind erysipelas and other complications are of course to be apprehended. The best plan is to make a free median incision, and others at the sides, turning flaps down sufficient to cover the framework of the nose without any tension, remove the intervening mass, and unite the flaps. Care must be taken not to open the interior of the nose by cutting through the cartilages, to avoid which the left forefinger must be kept in the nose.

Lupous and rodent ulcers.

Cancerous diseases.

The nose is peculiarly subject to the forms of ulceration spoken of at p. 403 as lupous and rodent ulcers, but I need add nothing here to what is said there and in the chapter on DISEASES OF THE SKIN on that subject. Epithelioma also is not uncommon at the angle of the nose, and should be early and freely removed with the knife, caustic being applied to the section if any tissue in it looks suspicious.

Malformations.

Congenital absence of the nose has been recorded, and it has even been said that plastic operations have been performed for its cure; but I confess that I do not understand how any surgical operation could restore anything like the natural appearance in such cases.[2] But in cases (which are also very rare) of congenital occlusion of one or both nostrils, or of adhesion between the nostril and septum, an operation may be of the greatest service, and should be at once undertaken, since the obstruction much interferes with sucking. The obstruction is sometimes merely membranous, while at other times a considerable depth of tissue has to be penetrated. A free opening into the nasal cavity should be secured and kept permanently dilated by means of a metal or gum catheter retained for many weeks, and the case should be watched to prevent recontraction. Similar in principle should be the treatment of occlusion or narrowing, the result of cicatrisation, the usual cause of which is lupus; but here the prospects of cure are far less encouraging, since the tissue of the cicatrix tends to recontract. The constant expansion of tents of laminaria may, however, ultimately overcome this tendency, if the patient will persevere.

Cicatrisation.

Deviations.

Deviations of the nose are very common to a slight and hardly perceptible extent. But sometimes, whether as the result of injury or as a congenital formation, the septum inclines so much to one side as almost to close one nostril, while the turbinated bone on the opposite side projects so much into the other as to be mistaken for a tumour. A little attention will enable the surgeon to avoid this error and explain the nature of the case; but no treatment has as yet, I believe, proved successful, though removal by the knife of a portion of the cartilaginous septum is recommended by Professor Gross.

[1] The name is so far inappropriate that the tumours are not fatty, but consist of hypertrophied skin and sebaceous follicles with connective tissue.

[2] See Holmes's 'Surg. Dis. of Childhood,' 2nd ed. p. 128.

Affections of the interior of the nose.

The examination of the nasal cavity may be made from the nostril, for which purpose special instruments are contrived, such as Fraenkel's nasal speculum, or Cresswell Baber's dilator, figured by Mr. Haward ('Syst. of Surg.' 3rd ed. vol. ii. p. 632): but for many cases the spoon end of a director, or a couple of directors introduced on opposite sides, will serve well enough: or the nose is examined by means of careful probing—very necessary in the search for foreign bodies: or by reflected light from the mouth, by which the posterior nares may be illuminated, as will be explained in speaking of Laryngoscopy, of which this examination, 'Rhinoscopy,' is a variety. It is a very difficult method of examination, but has afforded useful results in cases of foreign bodies impacted in the respiratory pharynx, and in tumours situated near the posterior nares.

Rhinoscopy.

Rhinolithes.

I have already spoken of foreign bodies in the nostril (p. 173), and of the importance of detecting and extracting them at the earliest possible moment. Such bodies sometimes attract inspissated mucous and purulent secretions, and thus form the nuclei of rhinolithes, or nose-stones, which are found, though rarely, in the inferior meatus, while at other times, as it seems, such concretions form without any foreign nucleus; and in any case of constant discharge and inflammation, for which no cause is obvious, it is important to examine the meatus thoroughly for one of these concretions. When detected it must be removed entire if possible, otherwise it can probably be crushed with a tolerably stout pair of forceps, and the fragments extracted or syringed out.

Epistaxis.

Epistaxis, or bleeding from the nose, is a very common affection, both in youth and old age. It occurs in consequence of injuries, though rarely to any great extent. In fractures of the base of the skull, as pointed out above (p. 148), it is sometimes copious and persistent. But the epistaxis which is usually the subject of treatment is spontaneous. In youth this is rarely of much consequence, except in persons the subjects of the hæmorrhagic diathesis. Any slight congestion will induce epistaxis in some children, but it will almost always subside. There are many ways of treating it in popular use, and their success is generally to be explained by the spontaneous cessation of the discharge. Cold to the spine, as by dashing cold water on the nape, or 'the nursery remedy of slipping a cold key down the back,' or raising the arms vertically above the head, certainly seem to stop the bleeding. But the direct application of cold, as by washing out the nose with ice-cold water or passing pieces of ice into the nostril and applying ice-cold lotion to the forehead, is still more efficient, and sometimes the injection of tinct. ferri perchlor. diluted is very serviceable.

In young women epistaxis is sometimes vicarious when the menstrual discharge is suppressed, and then requires no treatment except that which is directed to the re-establishment of the natural function.

In fevers and scurvy epistaxis is liable to occur, and sometimes can only be suppressed by plugging the nose.

In advanced life epistaxis is often indicative of cerebral congestion, and in such cases must be regarded with anxiety, though in itself and for the time, if not excessive, it will probably avert graver mischief.

Obviously, then, the treatment will depend on a knowledge of the cause, and as a general rule there is little occasion for any violent attempt at suppressing the hæmorrhage. It usually subsides of itself, having done only

good. If it seems necessary to suppress it by surgical means, a free washing out of the nose by the method to be presently described as Dr. Thudichum's, with ice-cold water, or with some astringent solution, hardly ever fails to stop it, except in the case of the depravation of the blood by the hæmorrhagic diathesis, or by fever or scurvy, in which cases and in some of the more violent hæmorrhages of later life it may be necessary to plug the nares.

Plugging the nares.

Plugging the posterior nares may be effected by means of Bellocq's sound, here figured. The sound is hollow, and carries a stilet of whalebone on a handle. The stilet has a large eye at its end. It is introduced along the floor of the nostril into the pharynx, and then by pressure on the handle the whalebone stilet is made to protrude, and curves round the soft palate into the mouth. The eye is drawn out as far as it will come (fig. 281), and the string on which the plug is fastened is then passed into the eye, and by withdrawing the instrument the string is brought out of the nose. There is then nothing to do but to draw the plug up to the posterior nares. The plug should be fastened in the middle of a long piece of string. It should be made of lint or sponge, and its size should be that of the first joint of the surgeon's thumb, which is a little more than the size of the posterior nares; so that the plug cannot be drawn into the nose. When lodged in the posterior nares there are two ends, one projecting from the nose, the other from the mouth. On the one which projects from the nose a plug should be strung, which fills the anterior nares, and on this the thread should be firmly tied, so that both plugs are kept securely in position. This is best done by sewing the string into the substance of the plug and making all fast with a secure knot. If both nares are plugged the strings should then be tied together. The other string which emerges from the mouth is to be left loosely tied to the anterior string, or secured on the cheek with a piece of strapping, so as not to irritate the soft palate. It is very useful in withdrawing the plug. If Bellocq's sound is not at hand a soft gum catheter is to be taken and perforated opposite its eye, so as to make it into a gigantic needle. This is passed through the nose into the pharynx, and its end is caught there, brought out of the mouth, and threaded. The plugs are very inconvenient to the patient, especially when, as is usually the case, both nostrils require plugging, since he can only sleep with his mouth open, and the strings are very much in the way. They may be removed in about two days. The anterior plug being removed, an interval of an hour or two may be given to see whether any bleeding persists. If not, by cutting the anterior string and drawing on the posterior, the plug is at once removed from the posterior nares.

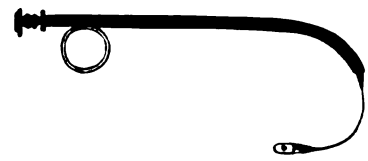


FIG. 280. Bellocq's sound.



FIG. 281. Plugging the nares.

It must be allowed that this is a most unpleasant proceeding for the patient, and not always an easy one for the surgeon. My friend Mr. Howard

has lately introduced into practice a much simpler contrivance, which I believe is usually effective. It consists of a bag of peculiar shape, to adapt itself to the nasal cavity when dilated, which is introduced by means of a probe or director, through the anterior nares into the pharynx, and is then blown up, and the air confined by means of a stop-cock which rests outside the nostril. If both nares require plugging it can be done on both sides. The bag keeps itself in its place, is introduced and withdrawn in a moment, and gives the patient the least possible amount of inconvenience. Other persons seem to have invented contrivances somewhat similar, but Mr. Howard's seems to me the best and most handy.[1]

Chronic thickening of the pituitary membrane.

Chronic coryza is a troublesome complaint, which sometimes lasts for years or for life, producing no ozæna or other unpleasant symptoms beyond catarrhal discharge and loss of the sense of smell. In other cases, and especially in strumous children, the mucous membrane becomes chronically thickened, especially over the end of the inferior turbinated bone, giving at first sight the impression of a polypus, and being very often mistaken for one, though most easily distinguished from it, by the absence of any stalk, by the immobility of the thickened membrane, and by its red, opaque tint.

The treatment of these chronic affections of the pituitary membrane is difficult. When the chronic thickening is obviously connected with struma the constitutional cachexia must be treated more than the local disease, though the persevering application of astringents and stimulants either in powder, lotion, or pulverised and injected into the nostril, seems often to do good. I have seen cases where it has seemed to me that the mistake of taking the thickened membrane for a polypus and tearing part of it off has done good instead of harm, though I should not venture to recommend the practice.

Adenoid vegetations.

There are cases at first sight nearly resembling chronic coryza, and doubtless often classed as such, where the muffled voice, the constant discharge,[2] and the deafness, which are so constantly met with in chronic cold, are caused by the presence of adenoid vegetations in the nasopharyngeal cavity. So that exploration of that cavity should always be made in such cases, and will soon reveal the nature of the malady. The vegetations should be removed with forceps of appropriate shape, or with a knife introduced through the nose, or with the galvanic cautery, until the nasopharynx is perfectly cleared. For further information on this affection the reader should consult Meyer, 'Med.-Chir. Trans.' vol. liii. p. 191, or Cresswell Baber in 'Brit. Med. Journ.' Aug. 5, 1882.

Ozæna.

One of the most terrible, as it is also one of the commonest, of the maladies which affect the nose is ozæna, or fœtid discharge from the nostrils. This occurs from many causes, of which syphilis and struma are the chief, but frequently also from no definite exciting cause, as far as our investigation enables us to determine. The mucous membrane becomes inflamed, possibly more or less ulcerated, and covered with crusts of inspissated discharge. There is also a horrible odour, not easy to describe, though when once experienced impossible to forget;[3] the discharge seems to disappear down the pharynx; at least none is perceptible externally in most cases.

[1] 'Brit. Med. Journ.' 1881, vol. ii. p. 896.

[2] The discharge, however, does not run out of the nostrils, but down the pharynx. The nose is usually somewhat flattened.

[3] The French call it 'punaisie,' from its resemblance to the smell of a bug.

True ozæna often lasts for years without any further changes, but the syphilitic variety will spread to the bones and cartilages, external openings will form, and the nose will be destroyed.

The victims of ozæna are usually young children, and their infirmity secludes them from the society of their playmates and interferes with their education, as well as rendering them miserable by the persistent odour.

The first thing in the management of this disgusting complaint is to ascertain its cause. I have already dwelt on the importance of making sure of the absence of foreign substances or nasal concretions. I have brought many a case of so-called ozæna to an end by removing a foreign body. The cure of the syphilitic ozæna must be undertaken by antisyphilitic measures, and by the application of mercurial vapours and lotions. It is a phenomenon generally of a late stage of syphilis or of the congenital disease. When it has spread to the bones abscesses must be opened and the general health attended to; but the shape of the features will hardly be preserved.

Thudichum's nasal douche.

In strumous ozæna the use of cod-liver oil with arsenic or of iodide of iron is generally indicated, and in this and the idiopathic form the use of the nasal douche, as explained by Dr. Thudichum,[1] is of the greatest importance. This method of applying solutions to the nose rests on a fact first noticed by E. H. Webber of Leipzig, that when the patient inspires deeply, and only through the mouth, the soft palate is so drawn against the posterior wall of the pharynx that the nose and respiratory pharynx may be filled with fluid which will run from the nostril into which it is injected over the upper surface of the soft palate and out of the other nostril without running down into the mouth or œsophagus. The apparatus necessary is a receptacle for the fluid, which must be raised over the patient's head to a sufficient height to ensure the requisite force of stream, so as to loosen the crusts from the membrane, an indiarubber tube proceeding out of this receptacle and a nozzle which will fill the nostril completely, so as to prevent any reflux. The patient is then to sit with his mouth open breathing exclusively through the mouth, and abstaining from any movement of deglutition.[2] A little practice soon enables him to pass the fluid through the nose without letting any run into his mouth, and till he has acquired the knack it is well only to use lukewarm salt-and-water. The constant stream detaches the crusts, and it can easily be increased or diminished in force by raising or lowering the receptacle, or by suddenly stopping and opening the tube. The detachment of the crusts is also much facilitated by reversing the stream, the nozzle being changed from one nostril to the other. The lotions recommended by Dr. Thudichum are—for mere ablution warm salt-and-water, which irritates the nose less than plain water; for deodorising purposes Condy's solution diluted, or carbolic acid lotion, 1 to 40; solutions of the alkaline phosphates (phosphate of soda, or phosphate of ammonia and soda) for dissolving the crusts and promoting their removal; as astringents, alum, sulphate of copper or of zinc; and as alteratives and specifics nitrate of silver, bichloride of mercury, or a solution of chloride of calcium, with suboxide or oxide of mercury suspended in it, made by mixing the ordinary black or yellow wash with common salt. In obstinate cases these applications must be often varied. Mr. Pugin

[1] 'Lancet,' Nov. 26 and Dec. 3, 1864.

[2] Special apparatus are sold for the purpose, but when these are not at hand a perfectly serviceable one can be extemporised with a common ewer and a syphon provided with a tube. The addition of a stopcock near the nozzle is convenient; but if there is none the patient can easily stop the stream when necessary by pressure with the thumb and finger.

Thornton[1] has spoken highly of the following lotion used cold in the form of spray by means of a handball apparatus:—Sodæ carb., sodæ bibor., āā ʒij.; liq. sod. chlor. ʒss.–ʒij.; glycerini ℥j.; aq. ad ℥viij.

Rouge's operation for ozæna.

Lately an operation has been introduced in practice by Dr. Rouge of Lausanne,[2] for the cure of ozæna, based upon the hypothesis that in many of these cases the bones are diseased—whether primarily, or in consequence of the ulceration of the soft parts which cover them—and that if the diseased bone be removed the disease will be cured, whilst without such removal the disease will go on for a time which is practically unlimited. And there can be no doubt that this is true of many cases of ozæna, though it is extremely difficult to diagnose the cases to which Rouge's operation is appropriate—nor is the operation itself by any means an easy one, or free from danger. The operation is of course performed under complete anæsthesia, and as the bleeding is generally very free, a good deal of trouble may be caused by the passage of blood into the air-passages—in fact, in a patient under my care serious danger was caused by the inhalation of blood into the lungs. The whole framework of the nose is to be lifted up by an incision made inside the mouth through the juncture of the nose and lip—the septum nasi and the lateral cartilages being divided with strong scissors till the bony opening is completely exposed. This being done the nasal cavity can be explored on either side very thoroughly, any bone found loose removed, and the ulcerated bone and the unhealthy mucous membrane scraped away, as far as may be judged prudent, for it must be recollected that death has been caused in operations of this kind by too great violence applied near the base of the skull. When the parts are replaced and fixed in position by strapping, they will adhere, and no trace of the operation will remain. The same operation is also applicable to cases of obstinately-recurring polypus. The difficulty experienced in cases of ozæna is as a general rule to know when, or in what cases, to recommend the operation. There are no doubt some cases (usually I think traumatic) in which dead bone is loose and produces a horrible fœtor; but in such cases the loose bone can generally be got away without incision. In many cases of ozæna exposed bone can be felt, but it is often only a portion of a large ulcerated surface, and the surgeon is disappointed in his attempt to remove it. In other cases, though the disease may have existed for a long time, no evidence of diseased bone can be found, and most likely there is none, or if there be, it is only a small part of the disease. Nor can the surgeon honestly represent to the patients or their friends that the operation is free from grave danger. Still the disease is so disgusting to others and so distressing to the patient that I consider the attempt at radical cure justifiable in cases which seem otherwise incurable, if after fair explanation the patient wishes to have it made. My own experience of the operation is limited to two cases, one of ozæna, and one of polypus, in neither of which was I satisfied with the result at the time. Yet the patient has in neither case consulted me again, though in both they promised to do so if the disease was not cured. I would refer also to a paper by Mr. Warrington Haward on Ozæna in the eighth volume of the St. George's Hospital Reports, or to the same author in 'Syst. of Surg.' 3rd ed. vol. ii. p. 648. Mr. Haward remarks that in many cases sufficient access to the nasal cavity will be obtained without the dangers of Rouge's operation by forcibly displacing the septum to the opposite side, under anæsthesia, and pushing it back into its place when the exploration is completed.

[1] 'Brit. Med. Journ.' March 27, 1880.

[2] 'Nouvelle Méthode pour le Traitement chirurgical de l'Ozène,' 1873.

Affections of the septum. Blood-tumours.

Deviations of the septum have been spoken of above. The septum is also liable to the formation of blood-tumours from injury, which affect both sides of the septum, and sometimes proceed to such an extent as to obstruct respiration and render an incision necessary. But this is rare. The affection is, it seems, usually accompanied by fracture of the septum. In most cases it will subside under the local application of cold.

Abscess.

Abscess of the septum is sometimes the result of injury, but it occurs also spontaneously, and sometimes in a chronic form, going on to perforation, which may produce a disagreeable whistling in speaking or deep breathing. The diagnosis of the complaint is sometimes a little difficult at first, the swelling being confounded either with polypus or chronic thickening of the Schneiderian membrane; but an attentive examination will show the difference in the seat of the swelling, and an exploratory puncture will clear up the case. Free and early incision is always desirable, and Mr. Durham says that benefit may be derived by injection of a weak solution of nitrate of silver or of some detergent lotion into the nostril. If the septum is perforated by a small opening and the unpleasant whistling sound distresses the patient, his condition may sometimes be relieved by making the opening larger.

Enchondroma.

The septum is not unfrequently the seat of cartilaginous tumours, which sometimes also spread to the other cartilages. Those I have seen have been of small size, and have grown into both nostrils, and it has been sufficient to remove such portions as could be got at from the nostril without any external incision. But larger tumours might require the free division of the nostril in order to allow of their complete extirpation.

Nasal polypus.

Nasal polypus is a very frequent, and in some of its forms (though these are fortunately the less common ones) a very formidable disease. The division generally made of nasal polypi, and that which best corresponds to what is seen in practice, is into three chief forms—gelatinous or mucous, fibrous, and malignant.

The first are by far the most common. They originate generally from the mucous membrane which covers one or other of the turbinated bones, more commonly, as I believe, from the middle, though opinions differ as to what is commonly their precise attachment; but all authorities agree that they rarely if ever spring from the septum or from the roof of the nose.[1] They are often multiple. Their structure consists of a fine fibrous tissue covered externally by the mucous membrane with its ciliated epithelium, whilst at other times adenoid structure is found in them as though from a hypertrophy of the glands of the part. The microscopic structure is generally of the myxomatous character (see pp. 849, 850). Other polypi approach more to the character of fibrous or fibrocellular tumours, and in some cysts are found developed. They produce well-defined symptoms by which the nature



FIG. 262. The common polypus of the nose. After Liston.

[1] 'Their most common seat,' says Mr. Spencer Watson, 'is the lower part of the middle turbinated bone, but they may in fact spring from any part of the nasal fossæ or their sinuses, though there is no recorded instance of their growing from the septum nasi, except one specimen in the museum of St. Thomas's Hospital.' Mr. Watson figures a polypus growing from the frontal sinus, and one springing from the orifice of the antrum.

of the disease may often be suspected before physical examination converts the suspicion into certainty. These symptoms are a mixture of catarrh and obstruction. The patient seems to be constantly catching cold and sneezing, but besides this he notices that his breathing is obstructed, he cannot sleep but with his mouth open, his voice is affected and acquires a nasal tone, he observes that he cannot breathe, or can hardly breathe, through the nostril; but the nose is scarcely ever deformed. The obstruction as well as the catarrh are noticed to increase in damp weather, when the tumour increases in bulk.

The proper course to pursue is to remove the polypus, but it frequently presents again, either in consequence of renewed growth from the base or from their having been really several polypi, of which one or more have been left behind unperceived. The best security against this recurrence is when the portion of bone from the covering of which the polypi grow has been designedly or accidentally removed along with them. Rouge's operation enables the surgeon to remove the whole of the polypi, and even to scrape away their bases from the bone, and this becomes still more easy when the growth of the tumours has distended the nostril.

Polypi may be removed either with the snare or the forceps. The snare is a loop of wire, the ends of which are passed into the tube of a double canula either before or after the loop has been conveyed around the polypus and pushed up as near its base as possible. The canula has a handle attached to it by means of which the wire is drawn through the base of the polypus gradually or rapidly, as the surgeon thinks best. Some operators even use the galvanic écraseur for this purpose, but, as far as I can see, without any sufficient cause. The main point is to get up to the root of the polypus, and I confess that it appears to me that this end is better attained by means of the common forceps. If the nostril is wide the tumour may be gently drawn down with one pair of forceps, while another is pushed firmly up to its attachment and the mass twisted off. Then, after bleeding has somewhat ceased, or next day, the nostril is to be carefully examined to see whether there are any others. The chief error made in the diagnosis of polypus is to confound the chronic thickening of the mucous membrane, which often occurs in strumous young persons, with polypus. When the end of the inferior turbinated bone is covered with this thick pulpy mass it looks at first sight exactly like a polypus; but careful examination can hardly fail to detect the nature of the case, if the surgeon is alive to the possibility of the error, since there is in this case no stalked pendulous soft tumour, as in the other, and the neighbouring mucous membrane will be found similarly, though perhaps less distinctly, affected. The success of astringents as applied for the cure of so-called polypus is, I suspect, more real in cases of this sort than in true polypoid growths. At the same time Mr. Bryant has spoken highly[1] of the success sometimes obtained by the insufflation of the powder of tannin (about

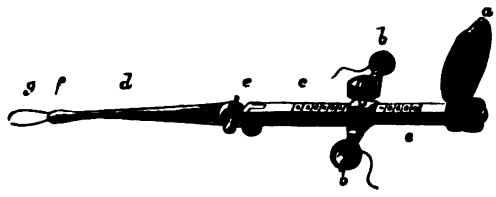


FIG. 283. Hilton's nasal polypus snare. *a*, ring for the surgeon's thumb; *b*, *b*, movable cross-piece, pushed backwards and forwards by the fore and middle fingers, so as to advance and retire the loop *g*, which in practice is far larger than is here shown. The stem *c* is hollow for the ends of the wire to run in. They are wound round the cross-piece. *e* is a hinge-joint, by means of which the stalk *d* which is in the nose can be placed at the requisite angle with the stem *c*. Its bulbous end, *f*, is perforated by two holes to convey the wire. The end of the wire is pushed round the polypus either with the fingers or a kind of fork.

[1] 'Lancet,' Feb. 1867.

ten grains blown into the nose with a tube) in some cases even of large polypi, though he owns that it is a very uncertain remedy. Mr. Reginald Harrison has had some success by merely incising or freely puncturing the polypus and then injecting a solution of carbolic acid and glycerine.[1]

Cases have been known in which the deviation of the septum has been mistaken for polypus, but this is mere carelessness. Tumours of the septum are distinguished from ordinary polypus by their position.

Fibrous polypus.

Fibrous polypi are far more formidable tumours than the gelatinous. They spring generally from the roof of the nasal fossæ or from the base of the skull behind the posterior nares,[2] and they grow into the nasal cavity, displacing the bones of the nose (causing the peculiar appearance called 'frog's face') or into the nose and pharynx at the same time (nasopharyngeal polypus). These

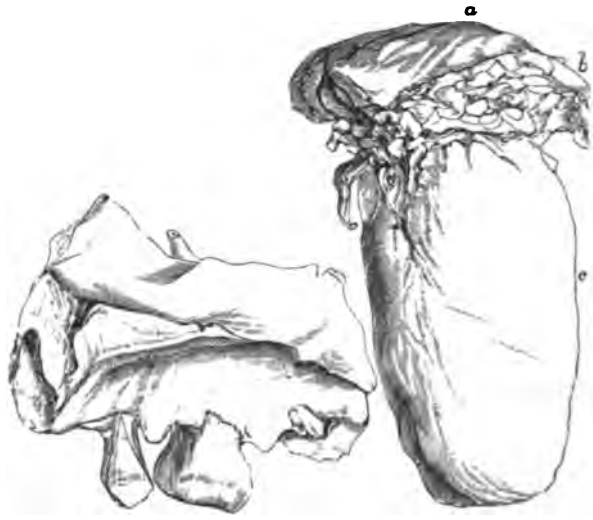


FIG. 284. A fibrous nasopharyngeal polypus, which had long caused epistaxis, so that the patient was exhausted by daily loss of blood. It was removed from the base of the skull by partial resection of the upper jaw in the year 1866. The portion of bone removed is figured with the tumour, and is seen to comprise the whole of the upper jaw, with the exception of its orbital portion. The tumour consists of two parts—*a*, that which projected into the nostril, and, *c*, that which hung down into the pharynx. Between these is a constricted part, *b*, where the mass was implanted into the base of the skull just behind the posterior nares. On microscopical examination it consisted almost entirely of fibrous tissue with some cellular elements. The patient remained well for some years, but gradually the bleeding recurred, and the tumour was found to be growing again. It was again removed eight years after the original operation, and was found to have the same structure. The patient again rapidly recovered his health and was seen quite well in July 1883.—See 'Clin. Soc. Trans.' vol. viii. p. 68.

polypi are usually accompanied by considerable bleeding, and I have known this bleeding allowed to go on so long (in consequence of its cause having been overlooked) that it threatened at last to prove fatal. Yet the tumours themselves are not so vascular as to occasion any formidable hæmorrhage on removal, though they get congested and their depending surface bleeds freely on being touched. Their continued growth causes various symptoms due to pressure on the neighbouring organs (deafness, epiphora, &c.), and they may even absorb the base of the skull and cause pressure on the brain. The extirpation, therefore, of the tumour is urgently indicated, and there are many ways in which this may be done. In some cases it may be possible to reach the base of the

[1] 'Brit. Med. Journ.' Nov. 15, 1879.

[2] I ought to mention that these tumours, besides their primary attachment, are sometimes implanted, as it were, into other parts of the nasal mucous membrane, where probably ulceration has occurred both on the surface of the polypus and of the Schneiderian membrane, and the ulcerated surfaces have coalesced.

tumour either from the nostril (if this is much dilated) [1] or, under anæsthesia, from the pharynx, the mouth being kept wide open by means of Smith's gag, and thus a wire can be conveyed round the base of the tumour, which can be connected either with the galvanic or common écraseur, or with the ordinary snare, and then the mass may be removed. In some cases it is perfectly easy to twist off the tumour from the mouth with a pair of curved forceps. But such cases are the minority. In most instances of fibrous polypus a way must be made by surgical operation through the tissues of the face to the base of the tumour, and this by one of three operations: (1) from below, through the hard and soft palate; (2) from above, through the nose; and (3) from the front, through the upper jaw. The first method is known as Nélaton's. It is little practised in this country and seems much inferior to the third in cases where the nostrils are not much dilated, and to the second in those where they are. The soft and hard palates having been divided with a knife, and as much of the palate processes of bone as may be necessary having been removed with the bone-forceps, the tumour is to be exposed and removed, and the palate then sewn up.

2. When the nose is much dilated ample room may be obtained by an incision on one side of the middle line from the roof of the nose to the nostril. The nasal bone is to be divided in the course of the incision, the soft parts turned aside, and the tumour exposed and removed. Then the wound is accurately adjusted by sutures, and unless any accidental complication interferes with union only a trifling mark will be left.

3. An incision is to be made along the lower margin of the orbit, and along the side of the nose, curving round the nostril to the middle line of the lip, and thence down to its free edge, and the cheek turned outwards. Then the hard palate is to be sawn through, and next the zygoma, and then the saw or bone-nippers must be carried through the nasal process below the orbit, and in this way the whole of the alveolar portion and body of the jaw are removed, when the operator will have free access to the base of the skull. After the tumour has been taken away the bone from which it grows is to be freely rasped, and the actual or potential cautery applied to the place of implantation.

Again, the whole upper jaw may be removed, or Langenbeck's method adopted, by which the soft parts are incised down to the bone externally and internally, as in the old method of removing the jaw; then the attachments of the bone are sawn through in the same lines, the palatal attachments divided, and the jaw with its coverings turned up over the eye, and after the removal of the tumour brought down again and fixed in its place by deep sutures; the soft palate being left undivided.

Malignant polypus.

Sometimes cancer grows in the form of a polypus from the mucous membrane of the nose.[2] Such tumours are usually of very rapid growth; they speedily dilate the side of the nose, and cause much hæmorrhage. They rapidly fungate out of the nostril, and are very apt to infiltrate the skin of the face. The patient is usually somewhat advanced in years, and the general

[1] When the nostril is much dilated the two forefingers may be used from the back and front at once to detach the tumour, the patient being completely anæsthetised.

[2] I had once under treatment a case in which the tumour was of the melanotic variety (spindled-celled sarcoma, with black pigment in the cells). It grew from the outer side of the nasal cavity, and was easily removed by laying open the nostril. The patient, a man of advanced age, recovered from the operation, but died from some affection of old age not long afterwards. Similar melanotic deposits were found on the lining membrane of the antrum.

health is much impaired. The diagnosis is not difficult, from the rapid growth of the tumour, the change of shape in the features, and the great cachexia which is commonly found.

The removal of the tumour is urgently indicated, for which purpose any of the plans previously proposed in the case of nasopharyngeal polypus may be selected according to the presumed attachments of the tumour, which, however, it is by no means easy to ascertain. Careful examination should be made both anteriorly and from the posterior nares with the finger, and if possible by rhinoscopy, before such an operation is attempted; and the surgeon ought to have the actual cautery and all other necessary hæmostatics ready, in case he finds the tumour implanted by a broad base of vascular tissue. After all, a speedy recurrence is to be feared.

CHAPTER XXXI.

SURGICAL DISEASES OF THE DIGESTIVE TRACT.

DISEASES OF THE TONGUE.

Tongue-tie.

TONGUE-TIE is a tolerably common deformity, which, in its higher degree, will prevent the child from sucking, and may hereafter interfere to some extent with articulation; though this is more spoken of than really proved. However, if the deformity be at all pronounced, it is well to perform the little operation which will release the tongue and restore its motion. If performed carefully this slight incision is free from danger of any kind. All that is necessary is to avoid dividing the ranine artery as it passes along the frænum linguæ. The tongue is pushed up and the artery shielded from harm either by the surgeon's fingers or by a slit in the flat end of the director, which used always to be made in this shape for the purpose. The incision or little nick need only extend through the semi-transparent edge of the constricting tissue, and the tongue be forcibly pressed upwards to the roof of the mouth, by which manœuvre the rest of it will be torn. I have performed this little operation a very great number of times—chiefly for the satisfaction of the parent—though in only a small proportion of them could I persuade myself that it was really indispensable. I have, however, seen cases in which the child undoubtedly could not take the breast till the tongue was released.

Ulceration of the tongue.

The forms of ulceration to which the tongue is liable are the irritable, the dyspeptic, the syphilitic, and the cancerous. The following are the rules for their diagnosis and treatment, abbreviated from one of the excellent clinical lectures of Mr. Cæsar Hawkins[1]:—1. *Irritable* ulcers are excited by the irritation of rough teeth; they also affect the lips; they are very painful, and afford considerable impediment to eating; are apt to become phagedænic, and are often accompanied by a good deal of indigestion. The haggard aspect of the patient produced by pain and want of food may cause them to be mistaken for cancer; but they are generally multiple, while cancer is single, and they lack any evidence of solid deposit around the ulcers.

The treatment consists in extracting or filing down the offending teeth, correcting the state of the digestive organs (by a mercurial pill, followed by a brisk purge, alkaline tonics and laudanum, &c.), and attending to the local condition of the ulcers by cleaning their surface with a poultice, and when clean touching them with nitrate of silver, either solid or in solution, which often relieves the pain considerably.

Dyspeptic ulcers.

2. Closely allied to these, but still more nearly resembling cancer, is the *dyspeptic* ulcer of the tongue, which arises without any local irritation, often as the result of psoriasis. This ulcer is usually situated at the middle of the tongue, which is an unusual situation for cancer; it is often accompanied by similar cracks and fissures in other parts, which have not gone so far as to form a definite ulcer; there is no hard deposit beneath the base of the ulcer, and there are signs of disturbance of the digestive organs. The diagnosis

[1] Contributions to 'Path. and Surg.' vol. i. p. 214.

from syphilitic ulcer must be made chiefly by the absence of the history and signs of syphilis.

The treatment is very much the same as in the irritable form, and of the tonics which become necessary in the treatment after the unhealthy state of the mucous membrane is corrected Mr. Hawkins especially praises arsenic.

Syphilitic ulcers.

3. The *syphilitic* ulcer when in its worst state forms a large excavation, with foul raised edges and sloughy surface on the back or sides of the tongue, which greatly resembles cancer. The diagnosis, indeed, cannot in all cases be confidently made without testing the efficacy of treatment, in persons who have had primary and secondary syphilis. At the same time there is in syphilis an absence of the characteristic induration of the cancerous ulcer, and a presence in most cases of other syphilitic symptoms which enables the surgeon to come to a correct opinion. The glands may be enlarged in either, but are more frequently so in the cancerous ulcer, since the syphilitic is usually a tertiary symptom, and in syphilitic ulcers if any glands are enlarged in the neck they are not usually the submaxillary, which are in direct connection with the ulcer, but the posterior chain of cervical glands beneath the trapezius. In doubtful cases the effect of a mercurial course will in all probability settle the matter. Mercury, however, should not in these late cases of syphilis be given either rapidly or in large quantities. The calomel fumigation is, I doubt not, by far the best form, and is very easily managed by adapting a mouthpiece to the vaporising machine and inhaling the vapour. Five grains of calomel every night is the quantity usually prescribed, or the ulcer may be dusted with grey powder (gr. v.) daily. In some cases sarsaparilla and iodide of potassium may be given when the surgeon dares not risk the debilitating effect of mercury, which, however, is very trifling when the method of fumigation is employed.

Cancerous ulcers.

4. The *cancerous* ulcer appears on the side of the tongue, generally at first as a small common ulcer, which is attributed to the irritation of a bad tooth; but the removal of this does not stop the disease (though I think there can often be no doubt that if the irritation of a bad tooth had not originated the cancer it is at any rate powerful in determining its outbreak at that precise spot), and soon a deposit of hard tissue is apparent at the base of the ulcer, which spreads an indefinite distance into the substance of the tongue, with much pain, salivation, difficulty in articulation, loss of appetite from the foulness of the discharge, and consequent cachexia. The glands below the jaw are apt to be affected early, and the sore will spread to the floor of the mouth or arches of the palate.

The diagnosis will follow from what has been said above on the other forms of ulcer. Though it may often be difficult or impossible at first, it becomes only too easy as the disease progresses.

Treatment of cancer of the tongue.

In doubtful cases the treatment consists in removing all irritating teeth (which, indeed, ought to be done in all ulcerations, whether cancerous or not), and treating the disease as either dyspeptic or syphilitic, as the case may be. If the cancerous nature of the affection admits of no doubt, the only question is whether a surgical operation is to be recommended, and if so, of what nature. If the glands or the floor of the mouth or the palate be implicated, surgical operations should be declined.[1] But if the whole disease can be

[1] Perhaps, if the pain and distress is great, and the affection seems merely epithelial, a surgeon may be justified in risking an operation, even though there be a few small hard glands under the jaw; but the general rule is as above.

cleanly removed the patient will no doubt derive much temporary benefit from the operation, though the disease will in all probability return in no long time.

When only a small portion of the tongue requires removal this is best effected by means of the knife or scissors. A clamp with curved blades being fixed around the part to be removed so as to control the vessels, the portion affected with cancer is to be completely cut away. The bloodless condition of the parts cut through enables the surgeon to judge much more certainly



FIG. 285. Mr. Henry Lee's clamp. The curved shape of the blades causes this clamp to make uniform pressure on all the tissue which it embraces.

whether those parts are healthy or no. When he is satisfied that all is as it should be, the arteries are to be tied and the clamp cautiously relaxed. Some surgeons, either instead of, or in addition to, the use of the ligature to the large vessels, use the actual cautery to the cut surface; but this is objectionable if it can be avoided, on account of the sloughing and fœtor which ensues.

Removal of part of the tongue.

When larger portions of the tongue are to be removed, either the ordinary écraseur or the galvanic écraseur[1] are preferable, as affording more security against secondary hæmorrhage, provided the chain is drawn

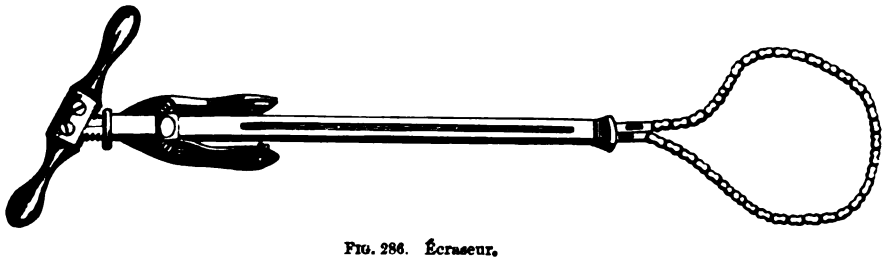


FIG. 286. Écraseur.

through the tissues very slowly. Hæmorrhage during or after the use of the écraseur arises generally from hurry on the surgeon's part.

In all operations on the tongue the surgeon should always have a com-

[1] The galvanic écraseur is a stout wire chain attached to the poles of a galvanic battery. The tissues to be removed are taken up by means of curved needles; the wire is then conveyed around them beneath the needles, drawn tight, and connected with the battery, when it turns white hot. As it burns its way into the tissues it is slowly wound up by a contrivance inside the machine, and so gradually cuts its way out. In practice it is well to have the battery managed by an electrical mechanician.

mand on the part left behind by means of a stout ligature passed through it, tied loosely, and held by an assistant, so that on the occurrence of acute hæmorrhage the tongue can be at once pulled out and the bleeding part exposed; and the mouth must, of course, be kept open by a gag, the smaller and stronger the better. Hutchinson's gag, here figured, is recommended by Mr. Heath, and is a very convenient one as taking up no room in the mouth.

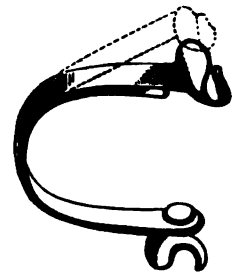


Fig. 287. Hutchinson's gag.

Removal of the whole tongue.

When the whole or the greater part of the tongue is to be removed it becomes necessary by some preliminary operation to obtain access to the root of the organ, and this is done in one of three ways: 1. A small incision may be made close inside the lower jaw from the mouth to the skin through which the chain of the écraseur can be passed; and the tongue being then pulled forcibly out of the mouth, the chain is passed around the base of the organ as near the epiglottis as practicable, and so the whole organ is removed except a stump, which is left attached to the hyoid bone. 2. Sir J. Paget recommends that, in order to render it easier to drag the tongue out, all the muscles which pass from the jaw to the hyoid bone should be divided on both sides as near the jaw as possible by an incision inside the mouth. When this has been done the tongue can be drawn almost entirely out of the mouth and removed either with the knife or écraseur. 3. But the method which gives the freest access to the root of the tongue is, doubtless, the division of the symphysis of the lower jaw. An incision is made in the middle line through the whole lower lip and drawn nearly down to the hyoid bone. Then the jaw is sawn through and the lingual muscles cut away from it close to the bone on either side. The halves of the jaw being held asunder, the tongue is forcibly pulled forward and to one side by means of a vulsellum, and its attachments to the hyoid bone severed on the opposite side, in doing which the lingual artery is cut across, and must be tied at once. The same manœuvre is repeated on the opposite side, in doing which it is desirable to get an assistant to hold the parts around the hyoid bone with a pair of strong claw forceps, in order to prevent the tissues which contain the severed end of the lingual artery from retracting down the neck. Then the second lingual artery and any other bleeding vessels having been tied, the glosso-epiglottic ligaments and the remaining attachments of the tongue are to be severed, and all bleeding vessels commanded. Then the severed halves of the jaw-bone must be united by means of a silver wire passed through them with a drill, the wound of the lip accurately closed with the harelip suture, and the patient kept under the influence of morphia for some time, and fed if necessary by the rectum.

Mr. Whitehead of Manchester has lately introduced a method of removing the tongue which has been extensively adopted and has at any rate the merit of simplicity. He thus describes his method in the 'Transactions of the International Medical Congress' (Surgery, p. 259).

The operation is conducted in six stages after the following simple manner: 1. The mouth is opened to the full extent with Mason's or any other suitable gag; and the duty of attending to this is entrusted to one of the two assistants required. 2. The tongue is drawn out of the mouth by a double ligature passed through its substance an inch from the tip. This ligature is given in charge to the second assistant, with instructions to maintain throughout

the operation a steady traction upwards and outwards. 3. The operator commences by dividing all the attachments of the tongue to the jaw and to the pillars of the fauces. 4. The muscles attached to the base of the tongue are then cut across by a series of successive short snips of the scissors, until the entire tongue is separated on the plane of the inferior border of the lower jaw, and as far back as the safety of the epiglottis will permit. 5. The lingual or any other arteries requiring torsion are twisted as divided. 6. A single loop of silk is passed by a long needle through the remains of the glosso-epiglottidean fold of mucous membrane, as a means of drawing forwards the floor of the mouth should secondary hæmorrhage take place.

The patient is fed for the first three days by nutritive enemata; satisfying thirst by occasionally washing out the mouth with a weak iced solution of permanganate of potash. The difficulties and dangers of the operation are few. Hæmorrhage is easily controllable. Mr. Whitehead twice removed the entire tongue without having to secure a single vessel, and more than once had only to twist one lingual artery. Other operators, however, who have used this method have complained of the quantity of foul discharge proceeding from the surface left by the scissors during the healing of the wound.

A table of twenty-eight cases, with one death the immediate result of the operation (an old man æt. 69), accompanies the paper. Two other deaths occurred in consequence of the operation, but from remote causes.

Latterly, seeing the great want of permanent success which has attended removal of the tongue for extensive cancer, in consequence of the frequency of recurrence in the glands of the neck,[1] surgeons have advocated more extensive operations in which the glands shall be removed as well as the tongue. In these operations external incisions are necessary, and a preliminary tracheotomy is highly desirable, indeed is absolutely essential if the operation is to be at all extensive. A free incision should be made through the cricoid cartilage and upper rings of the trachea, and the windpipe plugged with Trendelenburg's or Semon's tampon-canula. Then, if the floor of the mouth is diseased, a portion of the lower jaw is to be excised (the cheek having been freely divided) and the diseased tissues together with the enlarged glands dealt with as they are exposed. Kocher has introduced an operation in which a flap is turned down in the upper triangle of the neck by a curved incision from the angle of the jaw down to the hyoid bone, and up again to the symphysis, the lingual artery on that side tied, the enlarged glands dissected out, the opposite lingual artery tied if necessary by a separate incision, and the whole tongue as well as all other diseased structures removed. The great advantages of the preliminary tracheotomy are that it allows the pharynx to be securely plugged, so that there is no risk of suffocation from blood running into the windpipe, and that it preserves the patient from any risk of contamination from breathing the foul air which is so copiously generated in operations conducted on the ordinary method. Kocher's method has not, I believe, been adequately tried in this country; but he claims four cases of permanent success from it. There are also numerous other formal operations for removal of the tongue described, which differ chiefly in respect of the external incision, whether through the cheek or below the jaw. For these I would refer the reader to Mr. Barker's essay above quoted. The main practical point is as to the possibility of securing better results, in advanced cases, by more extensive operations, implicating the glands as well as the tongue, on which further experience is still required.

[1] See Barker in 'Syst. of Surg.' 3rd ed. vol. ii. p. 604.

The operation of removing the tongue is a severe and a very dangerous one, followed by great distress of mind and body, and often fatal by its ulterior consequences, even apart from its operative risks, which are nevertheless considerable. There can be no doubt, however, that it has often prolonged life, and rendered its remaining time more bearable to the patient, and therefore, under appropriate circumstances and at the request of the patient, this chance of relief ought not to be refused to him. At the same time I think it is one of the most unpromising of all the operations of surgery, and one which no surgeon undertakes without repugnance.[1]

It is curious that even after the removal of the whole tongue, as close as possible to its root, the patient is not quite deprived of the power of speech, though the voice is reduced to a hoarse whisper.

In some cases, in which the pain is great or in which the growth of the cancer is rapid, or where it bleeds profusely, the gustatory nerve has been divided, to relieve the pain; or the lingual artery has been tied, to check growth or to stop hæmorrhage. The division of the nerve is a very simple operation, which can do no harm, and the effect of which ought to be tried in any case in which pain is a prominent feature, or the patient suffers much from profuse salivation. 'The guide to the nerve,' says Mr. Moore,[2] 'is the last molar tooth. A line drawn inside the mouth from the crown of the last molar tooth to the angle of the jaw would cross it at right angles about half an inch from the tooth. An incision, therefore, in the direction of such a line three-quarters of an inch in length, and carried through the mucous membrane to the inner surface of the bone, must divide the nerve.' The nerve, as Mr. Moore mentions, is shielded by the alveolar ridge, so that it is necessary to take care that all the soft parts are absolutely severed down to the bone. The operation can be easily and safely performed on both sides, and may afford a good deal of relief for the time.

The ligature of the lingual artery is a much more difficult operation, and one liable to be followed by various grave consequences. It will be found described on p. 548. I have only had occasion to perform it once on a patient rapidly sinking under hæmorrhage, and then it quite failed in checking the bleeding, and in two other cases in which the operation has been performed at St. George's Hospital, its difficulty was more apparent than its utility.

Syphilitic affections of the tongue.

Syphilitic ulceration has been spoken of above in connection with the other forms of ulceration which are met with in the tongue. But there are various other syphilitic affections of this organ.

Mr. Fairlie Clarke [3] divides the syphilitic affections of the tongue into four classes: 1. Mucous tubercles or vegetations. 2. Superficial ulceration. 3. Gummatous tumours and deep ulcerations. 4. Morbid conditions of the mucous membrane.

Mucous tubercle.

1. The first, the mucous tubercle, is an early secondary symptom which affects both the papillæ and epithelium, the tubercles in which the epithelium is chiefly implicated being broad, flat, and whitish; the others small, prominent, and florid. They have much resemblance to the mucous tubercles

[1] I mean this observation to apply to operations in which the whole or the greater part of the tongue has to be removed on account of extensive cancer. In earlier stages of the disease the excision of portions of the tongue is no doubt urgently indicated, and in some it seems to be permanently successful, even when the disease is in the opinion of good judges epithelioma.

[2] 'Med.-Chir. Trans.' vol. xlv.

[3] 'Diseases of the Tongue,' ch. viii.

so often seen on other parts, and are distinguished from the papillary elevations of cancer by the absence of any hardening at the base.

Secondary ulcers.

2. The superficial ulceration is also usually a secondary affection. It spreads from similar ulcerations on the sides of the mouth and cheeks, forming superficial and very painful fissures, which in their healing leave milk-white scars; and if these are very numerous and the epithelium gets overgrown around them the condition named ichthyosis is present.[1] In other cases the superficial cracks spread out into large circular or oval sores.

Ichthyosis.

Gummata.

3. The gummatous tumours which form in the tongue are seen either at its edge, or more frequently close to the septum; and when they soften they leave the deep tertiary ulcer, or sometimes deep fissures which may implicate the whole organ and distort it. In other cases they become absorbed, and then may be followed by some distortion of the organ from loss of substance.

Syphilitic glossitis.

4. The syphilitic affections of the mucous membrane generally resemble psoriasis, consisting of a heaping up of epithelium of a dead-white colour over a limited area; in other cases the whole of the dorsum may be attacked with superficial inflammation (syphilitic glossitis), but this is often the result, not of syphilis only, but also partly of the abuse of mercury; and, according to Mr. Clarke, iodide of potassium, when it does not agree with the patient, may produce a similar affection.

It is rare for any of these syphilitic ulcerations to be accompanied by any glandular affection, belonging as they do to the later stages of secondary or to the tertiary period. Cases of indurated chancre of the tongue with enlarged glands are said to be met with, but I have not seen any such case.

The treatment of these affections has been already sufficiently indicated.

Inflammatory affections.

Annulus migrans, leucoplakia, or ichthyosis.

Certain conditions of the tongue which seem to be the result of mere chronic irritation have lately attracted much attention. These are the *annulus migrans*, as Mr. Barker (who first described it) calls it, 'a small round spot of a whitish or greyish colour, which rapidly develops into a more or less complete circle or crescent,' travelling over the dorsum, and sometimes affecting the under surface. It leaves the surface smooth and livid, is not followed by ulceration, and causes no symptom beyond some smarting in the use of particular kinds of food, and sometimes itching and salivation. No treatment has hitherto been found efficacious, but as far as is known it leads to no ill consequences.

The condition known as ichthyosis, or as Mr. Barker prefers to call it 'leucoplakia,' in which the tongue is covered more or less completely with dead-white patches, and sometimes deeply furrowed, is of much more importance, as being unquestionably often followed by malignant disease. The first description of this disease was, I believe, due to Mr. Hulke, at least in its relation to cancer; but it has since been extensively studied, and Mr. Barker's essay contains a full description of it with microscopical representations. There seems no doubt that it is a result of chronic irritation, by smoking or otherwise. Its connection with syphilis is dubious. Its treatment must be mainly prophylactic: i.e. limited to the withdrawal of all irritating aliments, abstinence from tobacco, and careful attention to the teeth. Mr. Barker speaks well of the use of soda lotions. Though this and the glazed red tongue are occasional precursors of epithelioma, yet the sequence is by no means a necessary one—in fact cases have been recorded where patients have suffered

[1] Mr. Barker, however, wishes to distinguish between the true ichthyosis, which he says is usually, if not always, independent of syphilis, and the syphilitic condition which is commonly confounded with it. The latter, he says, is easily cured by antisyphilitic treatment, the former only aggravated by it.

for forty years from ichthyosis without further harm. On the first supervention, however, of epithelioma the tongue should be removed freely beyond the limits of the part diseased.

Glossitis.

Acute inflammatory swelling of the tongue (acute glossitis) is by no means a common affection. It occurs from wounds, from mercurial or iodine poisoning, and from unknown causes. The swelling is sometimes so great as to threaten suffocation from backward pressure on the larynx, and in such cases the tongue should be freely and deeply scarified, in doing which it is useful to remember Mr. Holmes Coote's caution, viz. that the swelling is sometimes really more in the lower than the upper portion of the tongue, and that the lingual arteries have thereby been pushed up so that they may even appear on the dorsal surface of the organ. A little preliminary examination before the incisions are made will point out where they can be placed with safety. At the same time astringent gargles (alum, tannin, or iron) and warm fomentations should be assiduously used, and the patient's strength supported as may be necessary.

Most cases, however, which we see are not so severe as this, and require no incisions. In other respects they are to be treated in the same way.

Abscess in the tongue.

Inflammation of the tongue may end in deep-seated abscess, an affection which has before now been mistaken for cancer, and the tongue removed. Abscess forms a deep-seated, round, elastic tumour, situated in the thickness of the tongue. The shape and feeling of the tumour, the history of the case, and the resemblance to those chronic abscesses with which the surgeon is familiar in the female breast, ought at any rate to awaken suspicion, when an exploratory puncture will clear up the diagnosis, and a small incision will form all the treatment required.

Congenital affections of the tongue. Macroglossia.

A few other and much rarer diseases of the tongue require little beyond mention. These are: 1. The congenital hypertrophy to which the name 'macroglossia' is sometimes applied, in which the tongue becomes so large that the child cannot close his jaws or talk intelligibly, and which requires the removal of the central part of the tongue by amputation and the formation of side-flaps which are to be brought together to form a more convenient organ, an operation usually attended with great success.[1]

Congenital tumour.

2. Another congenital affection is a fibroid tumour which sometimes grows from the tongue, and which may be quiescent at first and then increase at a later period of life and require removal.[2]

Nævus.

3. Nævi also are found, but very rarely, on the tongue. They may be treated by electrolysis, the actual cautery, or some of the potential cauteries, or even by excision, or the ligature, should that be necessary, which, however, is seldom the case, since these nævi more commonly prove quite innocuous.

4. Finally, there are sometimes found embedded in the substance of the tongue fibrous or other innocent tumours, which may in some cases require removal.

DISEASES OF THE PHARYNX AND ŒSOPHAGUS.

Affections of the pharynx.

THE affections of the pharynx need not detain us long. Acute inflammation is constant in sore-throat of all kinds, in inflammation propagated from the

[1] The leading cases of this disease will be found reported by Dr. Humphry, Mr. Hodgson, and Mr. Teale in the 36th vol. of the 'Med.-Chir. Trans.' The disease is now believed to be caused by the lymphatic hypertrophy which is spoken of on p. 572.

[2] See Mason, 'Path. Soc. Trans.' vol. xv. p. 216.

spine, and in erysipelatous affections spreading inwards. But in all these cases the condition of the pharynx itself is of minor importance. The two former classes of cases have been spoken of along with the affections of the mouth and of the spine. The main importance of the erysipelatous affections, besides the ordinary dangers of erysipelas, consists in the risk of spasm of the glottis, which is peculiarly liable to complicate these cases, and which will be treated of in the chapter on DISEASES OF THE LARYNX.

Tumours of the pharynx.

Tumours sometimes arise in the pharynx, as in the remarkable instance which Mr. Holt has recorded,[1] in a man eighty years of age. Here a large pendulous fatty tumour springing from the wall of the pharynx extended nine inches down the œsophagus. It had been growing certainly more than twelve years, and occasionally caused symptoms of suffocation. At last, under some circumstances not fully explained, it suddenly obstructed the upper opening of the larynx and at once caused death. In cases such as this, where a tumour of the pharynx is pedunculated, there is no doubt that it should be removed. The patient should be brought fully under anæsthesia, the mouth widely opened by a gag, the tumour drawn fairly into reach by a vulsellum; then, if the neck is at all broad, or if there is any reason to apprehend hæmorrhage from its division, it should be perforated by a stout double ligature and firmly tied. Or else the tumour should be simply removed, the actual or potential cautery being at hand for use if necessary, and the surgeon should be prepared for the necessity of laryngotomy. The galvanic écraseur might also be used.

Malformations.

Malformations of the pharynx and œsophagus are not common. There are cases in which the pharynx is congenitally obstructed, and in which it opens into the larynx; but they are only of scientific interest, as the infant is not viable. More interesting in a surgical point of view is the pouched condition of the pharynx or œsophagus[2] which is sometimes found, probably either as a congenital defect or as the result of some atrophy and yielding of its muscular walls. A large pouch extends some distance down the tube, and the continuation of the œsophagus appears as an opening some distance above the bottom of the pouch. The result is that the food collects in the pouch, and is often rejected afterwards, producing a suspicion of stricture. On passing a bougie it is liable to be arrested in the pouch instead of finding its way down the œsophagus. The case from which Mr. Pollock's drawing is taken was believed during life to be one of stricture, nor is the diagnosis easy; but the patient will probably be able sometimes to swallow, the surgeon may happen sometimes to hit the natural opening, and the symptoms will probably not be so urgent as in stricture, so that a conjecture as to the nature of the case may perhaps be formed. No treatment is applicable—the course of the disease will to an attentive surgeon contraindicate the use of bougies, which, indeed, after the first exploration can only do harm.

Stricture of the œsophagus.

Stricture of the œsophagus is one of the most terrible diseases which afflict humanity. It occurs 'as the result of several distinct conditions: folds of the mucous membrane; cicatrices after injury; pressure occasioned by neighbouring tumours; thickening and contraction of its walls; or lastly, and most frequently, cancerous affection of the tube' (Pollock).

Little can be hoped from surgical treatment in these cases. It is, there-

[1] 'Path. Soc. Trans.' vol. v. p. 123.

[2] A beautiful illustration of this pouched condition will be found in Mr. Pollock's essay in 'Syst. of Surg.' 3rd ed. vol. vii. p. 546.

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spine, and in erysipelatous affections spreading inwards. But in all these cases the condition of the pharynx itself is of minor importance. The two former classes of cases have been spoken of along with the affections of the mouth and of the spine. The main importance of the erysipelatous affections, besides the ordinary dangers of erysipelas, consists in the risk of spasm of the glottis, which is peculiarly liable to complicate these cases, and which will be treated of in the chapter on DISEASES OF THE LARYNX.

Tumours of the pharynx.

Tumours sometimes arise in the pharynx, as in the remarkable instance which Mr. Holt has recorded,[1] in a man eighty years of age. Here a large pendulous fatty tumour springing from the wall of the pharynx extended nine inches down the œsophagus. It had been growing certainly more than twelve years, and occasionally caused symptoms of suffocation. At last, under some circumstances not fully explained, it suddenly obstructed the upper opening of the larynx and at once caused death. In cases such as this, where a tumour of the pharynx is pedunculated, there is no doubt that it should be removed. The patient should be brought fully under anæsthesia, the mouth widely opened by a gag, the tumour drawn fairly into reach by a vulsellum; then, if the neck is at all broad, or if there is any reason to apprehend hæmorrhage from its division, it should be perforated by a stout double ligature and firmly tied. Or else the tumour should be simply removed, the actual or potential cautery being at hand for use if necessary, and the surgeon should be prepared for the necessity of laryngotomy. The galvanic écraseur might also be used.

Malformations.

Malformations of the pharynx and œsophagus are not common. There are cases in which the pharynx is congenitally obstructed, and in which it opens into the larynx; but they are only of scientific interest, as the infant is not viable. More interesting in a surgical point of view is the pouched condition of the pharynx or œsophagus[2] which is sometimes found, probably either as a congenital defect or as the result of some atrophy and yielding of its muscular walls. A large pouch extends some distance down the tube, and the continuation of the œsophagus appears as an opening some distance above the bottom of the pouch. The result is that the food collects in the pouch, and is often rejected afterwards, producing a suspicion of stricture. On passing a bougie it is liable to be arrested in the pouch instead of finding its way down the œsophagus. The case from which Mr. Pollock's drawing is taken was believed during life to be one of stricture, nor is the diagnosis easy; but the patient will probably be able sometimes to swallow, the surgeon may happen sometimes to hit the natural opening, and the symptoms will probably not be so urgent as in stricture, so that a conjecture as to the nature of the case may perhaps be formed. No treatment is applicable—the course of the disease will to an attentive surgeon contraindicate the use of bougies, which, indeed, after the first exploration can only do harm.

Stricture of the œsophagus.

Stricture of the œsophagus is one of the most terrible diseases which afflict humanity. It occurs 'as the result of several distinct conditions: folds of the mucous membrane; cicatrices after injury; pressure occasioned by neighbouring tumours; thickening and contraction of its walls; or lastly, and most frequently, cancerous affection of the tube' (Pollock).

Little can be hoped from surgical treatment in these cases. It is, there-

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for forty years from ichthyosis without further harm. On the first supervention, however, of epithelioma the tongue should be removed freely beyond the limits of the part diseased.

Glossitis.

Acute inflammatory swelling of the tongue (acute glossitis) is by no means a common affection. It occurs from wounds, from mercurial or iodine poisoning, and from unknown causes. The swelling is sometimes so great as to threaten suffocation from backward pressure on the larynx, and in such cases the tongue should be freely and deeply scarified, in doing which it is useful to remember Mr. Holmes Coote's caution, viz. that the swelling is sometimes really more in the lower than the upper portion of the tongue, and that the lingual arteries have thereby been pushed up so that they may even appear on the dorsal surface of the organ. A little preliminary examination before the incisions are made will point out where they can be placed with safety. At the same time astringent gargles (alum, tannin, or iron) and warm fomentations should be assiduously used, and the patient's strength supported as may be necessary.

Most cases, however, which we see are not so severe as this, and require no incisions. In other respects they are to be treated in the same way.

Abscess in the tongue.

Inflammation of the tongue may end in deep-seated abscess, an affection which has before now been mistaken for cancer, and the tongue removed. Abscess forms a deep-seated, round, elastic tumour, situated in the thickness of the tongue. The shape and feeling of the tumour, the history of the case, and the resemblance to those chronic abscesses with which the surgeon is familiar in the female breast, ought at any rate to awaken suspicion, when an exploratory puncture will clear up the diagnosis, and a small incision will form all the treatment required.

Congenital affections of the tongue. Macroglossia.

A few other and much rarer diseases of the tongue require little beyond mention. These are: 1. The congenital hypertrophy to which the name 'macroglossia' is sometimes applied, in which the tongue becomes so large that the child cannot close his jaws or talk intelligibly, and which requires the removal of the central part of the tongue by amputation and the formation of side-flaps which are to be brought together to form a more convenient organ, an operation usually attended with great success.[1]

Congenital tumour.

2. Another congenital affection is a fibroid tumour which sometimes grows from the tongue, and which may be quiescent at first and then increase at a later period of life and require removal.[2]

Nævus.

3. Nævi also are found, but very rarely, on the tongue. They may be treated by electrolysis, the actual cautery, or some of the potential cauteries, or even by excision, or the ligature, should that be necessary, which, however, is seldom the case, since these nævi more commonly prove quite innocuous.

4. Finally, there are sometimes found embedded in the substance of the tongue fibrous or other innocent tumours, which may in some cases require removal.

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fore, of very great importance to distinguish between organic stricture or obstruction from the causes above enumerated, and the somewhat common affection called hysterical stricture of the œsophagus, or nervous dysphagia, which simulates the graver malady.

Nervous dysphagia.

Nervous dysphagia is more common in women than in men; it often is conjoined with symptoms clearly hysterical; the patient, in spite of alleged long-continued inability to swallow, is in good health and general condition; the dysphagia is not constant; frequently he feels less difficulty in taking solids than fluids, and sometimes the patient can be proved to be able to swallow quite well when no one is looking.[1] Such cases, like cases of nervous disease in other organs, require judicious management more than medical or surgical treatment.

The symptoms produced by stricture of the œsophagus may be summed up in two words—dysphagia and emaciation. The patient is at first able to take small quantities of solid food when well chewed and lubricated, then he is gradually conscious of increasing difficulty, and sometimes the œsophagus rejects the food which it cannot drive down, then he is restricted to fluids, and soon he sinks from exhaustion, if not cut off by some of the local consequences of ulceration about the stricture.

It is by no means easy to distinguish the various forms of stricture from each other. Those which proceed from cicatrisation will be known by their history, if the accident which caused them is remembered, but this may not be the case. The malignant will differ from the innocent stricture by occurring generally later in life, by the implication of the glands of the neck, by the more rapid cachexia, and by the tendency to implication of the larynx and neighbouring organs. Obstruction from a tumour is generally caused by aneurism of the aorta (at least when caused by a tumour of any other nature the cause is usually obvious), and it therefore occurs always at the part where the aorta is in contact with the œsophagus, so that the difficulty is referred to the upper part of the chest. In such cases very careful examination is necessary before the diagnosis is made, and above all before a bougie is passed. Cases are known in which the instrument has perforated the aneurism and produced instantaneous death. Careful auscultation and percussion of the chest, and the examination of the pulse in both wrists by the sphygmograph, if available, are indispensable; and it should be ascertained whether any of the other symptoms of aneurism are present—the ringing cough, the pain in the back, the so-called rheumatic pains about the neck, &c.

The innocent forms of stricture are fatal only by starvation; but malignant disease very commonly produces death by spreading into the larynx[2] or into one of the great vessels.

It is justifiable, and indeed necessary in the first instance to pass a bougie, except in advanced stages of cancer, in which case no mechanical interference is justifiable, since the bougie has often passed through the softened tissue of the cancer into the pleura, pericardium, or great vessels. When the seat of the obstruction has been ascertained the next question is, whether the stricture can

[1] Sir J. Paget, in his interesting essay on 'Stammering with other Organs than those of Speech' ('Clin. Lectures,' p. 82), has pointed out that the difficulty of swallowing may in many of these cases be analogous to that in stammering, viz. an inability from mental causes to co-ordinate the various muscular actions which are necessary to deglutition. If the patient knows he is being watched or directs his mind too anxiously to what he has to do, he cannot swallow, whilst if he is easy and unconcerned he feels no difficulty. In some cases the patient also stammers in speaking.

[2] Or it may be itself an extension from the larynx, though this seems less common.

be treated. If it is clearly cicatricial, the cicatrix might be divided by either external or internal incision, certainly not without very great danger; but, under circumstances such as these, danger would justifiably be incurred. In the 'New York Medical Record' for November 11 and 18, 1882, Dr. Roe has collected fifteen cases, including two of his own, in which internal œsophagotomy had been practised. In the second of his cases a boy æt. 8, suffering from a stricture the result of swallowing a caustic fluid, was restored to the complete power of natural deglutition by repeated shallow incisions into the stricture, followed by dilatation. The operation, if due care be taken, seems less dangerous than might have been anticipated. In only two of the fifteen cases was death said to be due to the operation itself. Four of the others died after the operation from various causes.[1] Billroth has attempted the extirpation of a cancerous deposit in the œsophagus, but the operation is not usually regarded as justifiable. I have alluded to the possibility, in cases of stricture not obviously malignant, of preserving life by gastrostomy (p. 218) or œsophagostomy (p. 195); and the attempt is certainly worth making. Failing these means, the only thing that can be done is to keep the passage open by means of bougies; and in spite of the known and admitted dangers of the treatment, I cannot but think that it is the best course for the patient, unless the cancerous symptoms are so urgent as to deter the surgeon, from fear of rupturing the œsophagus. If the bougie can be passed the patient will be able to swallow, and so will be kept free from the terrible pangs of starvation for a time.

Internal œsophagotomy.

In cases where the passage of a bougie is indicated, but where there is difficulty or danger in its introduction, M. Krishaber[2] has recommended the passage of a tube by the nostril, which is then left in permanently, the patient being fed by injections through it. He refers to five cases in which he has followed this course, one of a malignant tumour implicating the pharynx and larynx in which the tube was worn up to the time of the patient's death, a period of 305 days, and two others, also cases of malignant disease, in which the tube had been worn for 167 and 126 days respectively, up to the date of the paper. He also teaches that cicatricial strictures may be dilated in the same way as in the urethra by the continuous presence of the catheter, and that this method is of great use in extensive operations on the mouth and larynx; in which cases it should be introduced some days before the operation, so as to insure tolerance of it by the patient.

If nothing else can be done, the prospects connected with the operation of opening the stomach or œsophagus should be explained to the patient, and at his request the operation should be undertaken.

AFFECTIONS OF THE INTESTINAL TUBE.

Internal strangulation.

The strangulation of a portion of the intestine inside the abdomen is an even graver evil than its strangulation in a hernial sac, since, though it is not so rapidly fatal (perhaps because usually not so acute), it is much less susceptible of relief. The causes are very numerous, and by no means easy to diagnose. A common one is the formation of adhesions from previous peritonitis. Such adhesions sometimes unite with an appendix epiploica or the edge of the mesentery to form a ring passing round one of the coils of bowel, and the contraction of the material which forms this ring, or the accidental enlargement of the

[1] See 'London Med. Record,' April 15, 1883.

[2] 'Transactions of the International Med. Congress,' Surgery, p. 190.

contents of the bowel, seems to cause the constriction. At other times the constricting agent is formed by a mere band passing from one coil of intestine to another, and pressing the bowel against the wall of the belly behind; or the bowel may be bent or twisted on itself (volvulus), and thus the passage of fæces through it may be stopped; or the pressure of tumours in its neighbourhood, or stricture of its walls, may produce the same result; or, finally, a portion of bowel may slip into the tube below, just as the finger of a glove may be shortened by slipping one part of it over the other—intussusception—a condition which sometimes produces strangulation, but not always. Intussusception must be spoken of by itself. The other conditions are indistinguishable from each other unless the cause which produces them is within the reach of the hand. The great point is to distinguish, if possible, the part of the bowel affected, in order to determine whether a surgical operation for its relief is feasible. The main diagnostic symptoms are these: Strangulation produces at first constipation, then vomiting, which afterwards becomes fæcal. The higher the obstruction is situated in the intestine the sooner will the vomiting commence; but if the obstruction is high up it will not rapidly become fæcal. The amount of nourishment which the patient has taken will, however, influence this to some degree. Usually he is both unwilling and unable to take anything; but if the diet has not been restricted, so that the stomach and upper part of the bowel are filled, vomiting will probably commence earlier than would have been the case under more judicious treatment. All the symptoms are more acute when the obstruction is high up. When, on the contrary, it is seated in the large intestine or close to the end of the small, the belly will sometimes continue to swell gradually without any vomiting for several weeks, and the patient suffers little except the loss of appetite consequent on repletion and constipation. Another most important diagnostic sign is the quantity of water which can be injected into the bowel. If the obstacle is situated at the sigmoid flexure of the colon it is rarely possible, even with the utmost gentleness, to inject more than about a pint and a half before it is expelled, and usually with some force. The higher up the obstacle is situated the larger is the quantity which will pass in; and if the small intestine is the part affected, a very large quantity of fluid may be passed up, especially if the patient is narcotised, and will at first run out quite gently until the bowel is roused to expulsive action. Palpation of the abdomen is of course useful, and it is said that auscultation while the fluid is being injected may sometimes give valuable information of the position of the obstacle, but I have never been able to realise this.



FIG. 288. Internal strangulation of a coil of intestine by a band of peritoneal adhesion, which passes on to the surface and mesentery of a neighbouring coil of gut. The band has been displaced from the groove which it has worked upon the strangulated bowel, in order to show the extent to which the latter is constricted.—St. George's Hospital Museum, Ser. ix. No. 158.

Impaction of fæces.

During the constipation much may be done to alleviate the patient's sufferings. The first question is, whether the constipation depends on a real organic obstacle or merely on impaction of fæces, which will produce the same symptoms if long neglected. Such masses of impacted fæces are comparatively

often mistaken for tumours. The distinction is made by observing that though there may be a good deal of swelling around the bowel, the substance is to some extent soft and will take the impression of the fingers; that its size has been known to vary with the state of the bowels; and that there is the history of neglected constipation. If the mass is situated within reach of the anus it should be broken down with a scoop, otherwise free purgation and injections should be employed.

Treatment of obstruction.

But when an invincible obstacle has been proved to exist, the first rule of practice is to abstain from irritating the bowels with purgatives, to give nourishment in the fluid form only, and in the smallest possible quantities at a time, and to soothe the patient's sufferings with opium, subduing thirst with small pieces of ice kept in the mouth. As to surgical operations they are directed either to relieve the strangulation or to give an artificial exit to the fæces above it. The former can only be used in cases of strangulation by adhesions. It was successfully carried out by Mr. Bryant,[1] in a case in which there was a hernial sac, but no strangulation, and where the band was reached by carrying the incision which had been made into the sac a little upwards. Mr. Bryant thinks that such bands are more common when there has been hernia, so that the existence of a hernia may encourage the surgeon to attempt the operation. In the only case where I have myself operated I found a band crossing the lower part of the ileum (a very common situation), and divided it, but the operation had been put off too long, and the bowel gave way on the division of the band, having been previously almost perforated by the constriction.

Colotomy.

Colotomy may be practised on either side when the seat of obstruction is clearly localised in the large intestine. It is more commonly practised on the left side (descending colon) in obstruction and other affections of the rectum, and is more promising on this than on the other side, partly because the descending colon is less often provided with a mesentery than the ascending, but chiefly because affections of the rectum exhaust the patient less, and are more easily diagnosed, and therefore more promptly treated, than those situated higher up. When the obstruction is complete, and the flank is distended by the swollen intestine, the operation is an easy one; but when performed for the relief of cancer or other affections which do not produce complete obstruction, and the gut happens to be collapsed, it is sometimes very difficult. A free transverse incision is to be made midway between the ilium and last rib, and the edge of the erector spinæ is to be sought. A free incision should then be made into the fascia lumborum, i.e. the aponeurosis, which bounds the external edge of the erector spinæ and quadratus lumborum (the muscles themselves being of course left untouched), and this will expose a cellular interval full of fat between the fascia lumborum and the proper fascia (or fascia transversalis) covering the posterior wall of the bowel. This fascia is now to be carefully sought for through the fat which surrounds and covers it. The peritoneum may be distinguishable from this fascia, but it generally is not so. If, however, the bowel is much distended there is little risk of opening the peritoneum. When much difficulty exists in finding the intestine the lower end of the kidney forms the surest guide. The bowel is sure to be found just below and in front of the kidney, on careful search. It is then to be drawn up to the surface, stitched to the two edges of the wound, and opened between the stitches to an extent sufficient to admit the end of the finger, after which the mucous membrane of the bowel is to be carefully attached to the skin

[1] 'Med.-Chir. Trans.' vol. l. p. 65.

around the whole circumference of the opening. It is well not to make the opening too large, as the posterior wall of the intestine is sure to protrude from it afterwards. The intestine will become adherent to the wound before the sutures have come out, and after all has become consolidated and the patient has got up, a plug of ivory or glass can be fitted on to the opening and fixed by an elastic bandage. The bowels will very often regulate themselves, so that the action will occur usually at stated periods and the patient be quite clean and comfortable.

The operation on the right side is performed in exactly the same way. The horizontal incision (Amussat's) is generally preferred to Callisen's plan of making a vertical incision at the outer border of the erector spinæ. Mr. Bryant has proposed cutting obliquely, at an angle of 45°, as less likely to injure the vessels and nerves of the part.

Gastrotomy for obstruction.

When the surgeon has made up his mind to look for the seat of strangulation inside the peritoneum (an operation often described by the name Gastrotomy, see page 217) he usually makes an incision through the linea alba below the umbilicus, as in ovariotomy, long enough to get the fingers in, feels for the seat of stricture by tracing down the distended bowel, passes a director under the adhesion when found, and divides it with a hernia-knife.

Littre's operation.

Another plan which is sometimes justifiable is to make an incision on the distended intestine wherever it happens to be perceptible, and attach it to the skin (Littre's operation, called also 'gastro-enterotomy' or simply 'enterotomy'), so as to make an artificial anus in the small intestine. This is best done in the groin, when possible, by making a short incision over one of the projecting coils of bowel, as near the cæcum as possible, allowing the bowel to protrude of itself, stitching it to the wound, and opening it without handling the gut in any way.[1]



Fig. 289. Intussusception.—From a preparation in the Museum of St. George's Hospital.

Intussusception.

Intussusception, or invagination, is very much more common in childhood than in adult life; it occurs more frequently in the small intestine than in the large, though either may be affected. In children the intestine is so irritable and so lax in texture, that it is often found intussuscepted to some extent after death, when there is no reason whatever to think that

[1] There are at least three successful cases on record: one by Mr. McCarthy, 'Med.-Chir. Trans.' vol. lv.; one by Mr. Wagstaffe, 'St. Thomas's Hosp. Reports,' 1873; and a third by Mr. Maunder, 'Clin. Soc. Trans.' vols. ix. p. 102, x. p. 7.

any such condition has existed during life. The greater frequency of intussusception in childhood is partly accounted for also by the irritation of worms. Intussusception sometimes depends on the growth of tumours from the mucous membrane of the bowel. There is a remarkable preparation illustrating this in the Museum of St. George's Hospital, and I recently met with a case in an infant where several small sarcomatous tumours sprang from the surface of the bowel and produced intussusception. In early life it is most common for the ileocæcal valve, which is very movable in the child, to slip into the large intestine, and this sometimes to such an extent that the valve is carried down to the anus. Dr. Bristowe says that this ileocæcal invagination, occurring under the age of 7 years, forms about half the total number of cases, while intussusception of a higher portion of the bowel (jejunum or ileum) is only met with in adults, and forms about one-third of the fatal cases. Intussusception occurs in two main forms—chronic and acute. In the chronic form there is often no complete stoppage, but the invaginated intestine becomes more and more matted to that into which it is thrust, the passage of fæces through it becomes sluggish, pain comes on from the local inflammation, vomiting sets in and becomes constant; the patient loses appetite and strength, and must inevitably ultimately sink. In the acute form there is considerable pain from the first, with complete obstruction, straining to pass fæces, but only a little bloody fluid passing;[1] a sausage-shaped tumour can often be felt in the part to which the pain is referred, the neck of the invaginated portion is acutely constricted, ulceration sets in, the intussuscepted part is detached and drops loose into the bowel. Frequently this is accompanied by perforation and fatal extravasation of fæces into the peritoneal cavity, but in many cases the intussuscepted portion has been passed per anum, and a natural cure has thus been effected.

The diagnosis is difficult in some cases, clear enough in others, when either the intussuscepted portion can be seen or felt from the anus, when the movements of the intestine can be felt in the sausage-shaped tumour, when the latter changes place from one part of the abdomen to another, or when the sudden accession of obstruction, with the straining to pass a little bloody fluid, and the painful sausage-shaped tumour, point almost unmistakably to the nature of the disease.

The treatment consists (1) in endeavouring to disengage the invaginated intestine, or (2) to support the patient through the period required for its natural separation. There can be no question that in many cases the inflation of the intestine by air or water pumped into the anus has been followed by the complete subsidence of the symptoms and recovery. It is quite true that the air or water cannot pass the ileocæcal valve, and therefore it is difficult to see how any good can result if the intussusception be seated, in the small intestine. But then, again, no harm will be done, and the attempt seems worth making, especially by insufflation: but to be effectual it should be done early. Kneading the abdomen has sometimes succeeded. These milder measures failing, it is best in acute cases to endeavour to support the patient's strength by nutrient enemata with very small quantities of concentrated food and stimulants, and administer opium liberally in order to give him the chance of spontaneous cure. Mr. Hutchinson succeeded in a very remarkable case in cutting into the linea alba and drawing out an

[1] Bleeding seems to occur in intussusception either from congestion of the intussuscepted portion, when the latter is not strangulated, from ulceration at the neck of the strangulated part, or very probably from congestion or irritation of the receiving or ensheathing part.

intussusception so large that the ileocæcal valve protruded from the anus; the intussusception had lasted some weeks; the patient, an infant, recovered;[1] and Mr. Howard Marsh soon after operated in a similar case with equal success.[2] Since the occurrence of Mr. Hutchinson's case, the attempt has been several times repeated. A second case by Mr. Hutchinson,[3] one by Dr. Hilton Fagge and Mr. Howse,[4] one by Dr. Handfield Jones and Mr. Herbert Page,[5] and especially a very interesting one by Dr. Sands[6] deserve study, and the last-named more especially because the operation was performed in the acute stage of the affection, about 18 hours after the commencement of the symptoms. The patient was an infant one year old, and the operation proved successful. Dr. H. Jones and Mr. Page's case is of especial interest as an instance of double intussusception, and the operation seems to have been fully justified, though it was not successful. In this as in some other cases reduction was effected rather by kneading, or upward pressure, of the ensheathing bowel than by traction on the invaginated part.

The question of the justifiability of such operations is thus doubtless settled. The recorded experience is quite sufficient to prove that a surgeon may, if he thinks fit, open the abdomen for the relief of intussusception either in the acute or the chronic form. But our experience is obviously insufficient as yet to enable us to lay down any definite rules, if indeed definite rules be possible. It is clear that where the symptoms are acute, the operation is far more dangerous, and if it is to be performed at all it should not be delayed, as Dr. Sands says, beyond twenty-four hours. Now in such cases it is hardly possible to say whether the bowel may not become unfolded, or whether it will not slough, and the patient recover spontaneously. Without dogmatising on the matter, I would merely say that the operation has, as far as I can judge, only been proved to be *necessary* in cases like Mr. Hutchinson's original one, where the invagination is chronic, where it is obviously insusceptible of spontaneous recovery, and the patient is therefore sure to sink from exhaustion. In acute cases, and in the numerous class which can hardly be ranged under either head, the surgeon is justified in interfering if after a careful review of the symptoms he judges it to be for the patient's benefit, but the success of the attempt will always be very dubious, and the operator will often find reason to think that he had better have abstained. In acute intussusception, if the operation be postponed for even a very short time, it may be found impossible to disengage the bowel. When this is the case the only prospect of the patient's recovery is in the removal of the whole of the affected intestine, the vessels in the mesentery being first secured, and the two portions of bowel afterwards sewn together. I witnessed this operation lately in the practice of my colleague Mr. Pick, and Mr. Howse at a recent meeting of the Clinical Society spoke of having performed it twice; but as far as I know the attempt has not yet been successful.

Resection of portions of the alimentary canal.

Little success has as yet attended the operations of a similar nature which have been practised for other causes. In various conditions of obstruction the affected bowel has been removed, whether on account of gangrene, ulceration, or malignant disease; but the operation is a very severe and protracted one, and even if the patient were to rally from the first shock it is extremely difficult so to unite the two portions of the bowel as to ensure their holding together and retaining their contents when again distended.

[1] 'Med.-Chir. Trans.' vol. lvii.
[2] Ibid. vol. lix. p. 79.
[3] Ibid. p. 99.
[4] Ibid. p. 85.
[5] Ibid. vol. lxi. p. 301.
[6] 'New York Med. Journ.' June, 1877.

Resection of the pylorus.

The pyloric end of the stomach and the neighbouring portion of the duodenum have, however, been removed on account of cancer several times, and in one at least, Wölfler's case, the cure seems to have lasted some time. In two others, Billroth's first case and Czerny's case, the patients recovered from the immediate effects of the operation. The proceeding, however, is one which can very rarely be feasible. I must refer the reader to Mr. Pollock's observations in the 'Syst. of Surg.' 3rd ed. vol. ii. pp. 740 *et seq.* for a description and criticism of the operation.

Exploration of the rectum with the whole hand.

Very useful information may sometimes be obtained in pelvic and abdominal diseases and tumours by passing the whole hand into the bowel, which may be accomplished under anæsthesia by gradually dilating the anus with the fingers pressed together in a conical form. The hand may then be buried in the bowel as far as the wrist, and the parts examined about as high as the kidney, between the hand in the bowel and the one outside, much more satisfactorily than by any other method of exploration. The stretching of the anus leaves some incontinence of fæces, but only for a few days. Care must, of course, be exercised not to dilate the parts too rapidly, and not to rupture the wall of the bowel.[1]

Umbilical fistula.

I ought, perhaps, to mention the rare cases of discharge from the navel. This discharge may be of various kinds and arise from very different causes. In childhood a small vascular protrusion is found occasionally at the navel, which may grow to some size and then become irritable and bleed or suppurate. This protrusion is congenital, and is somehow connected with the ligature of the umbilical cord. All that is necessary is to pass a ligature firmly round the base, after having carefully ascertained the absence of any hernia.

Again, fæcal or biliary fluid is sometimes discharged from the umbilicus. Such discharges are connected with some malformation of the omphalo-mesenteric duct, and are, as far as I have seen, incurable. Two cases have come under my observation, in one of which the fluid appeared to be pure bile; in the other it was mixed with the contents of the intestine, and portions of the food, such as the pips of fruit, would occasionally appear in it.

In other cases the discharge seems merely purulent, and connected with an abscess in the parietes or subperitoneal tissue which has found its exit through the umbilicus and become sinuous. The best way to treat such cases, I think, is to dilate the opening as much as possible with sea-tangle tents and wash out the cavity with carbolic lotion. I have treated a case of this kind in this manner with rapid success.

Finally, there are cases (especially in very fat persons) in which discharge from the umbilicus is produced merely by heat and cutaneous irritation. These cases must be treated like intertrigo—of which, indeed, they are the sequelæ—by great cleanliness and keeping the parts from rubbing against each other by dusting the skin with oxide of zinc, and inserting tents steeped in tannin or nitrate of silver lotion.

Paracentesis abdominis.

The operation of paracentesis is required, in cases of ascites and ovarian dropsy, to relieve the patient from the distress caused by distension. It is performed by preference in the linea alba, about half-way between the umbilicus and pubes, though in cases of encysted dropsy it may become necessary to tap wherever the fluid is found, care being taken to avoid the course of the epigastric

[1] A paper by Mr. Walsham on the exploration of the pelvis by passing the hand into the rectum, in 'St. Bartholomew's Hospital Reports,' vol. xii., deserves careful study.

artery.[1] If the patient has not made water lately he should be instructed to do so, or the emptiness of the bladder should be satisfactorily ascertained. It used to be usual to tap in the sitting posture, but this is far less convenient than the recumbent. The patient is brought to the edge of the bed and turned on his side, so that the prominent abdomen projects beyond the edge of the bed. Then the operator having ascertained by percussion that the place at which he proposes to tap is perfectly dull, and that the fluctuation is plainly perceptible there, makes a small puncture with a lancet, if the patient is at all stout, and introduces his trocar and canula. A piece of tubing may be applied on the canula, so as to obviate wetting the bed with any of the fluid, or the same end may be obtained by holding something under the mouth of the canula to direct the fluid into a pail on the floor. No compression or disturbance of the abdomen of any kind is needed, the fluid is emptied by atmospheric pressure, and when it ceases to flow the puncture is to be closed with a piece of strapping, and a pad and a bandage applied. I have never seen any harm in this little operation, but no doubt the bowel has been wounded from a too free thrust of the trocar.[2]

Paracentesis is also used in hydatid tumours of the liver. I hardly think this the place for discussing the diagnosis or treatment of these cases. They have been successfully dealt with by electrolysis, by incision, and free washing out of the cyst, and by keeping several catheters in the opening, and constantly washing out the cavity through the catheters, the original opening being dilated by passing fresh catheters along the side of those previously introduced. I would recommend the reader to study the papers by Dr. John Harley, in the 48th vol. of the 'Med.-Chir. Trans.,' and by Dr. Hilton Fagge and Mr. Durham, in the 54th vol. of the same series.

Operations on the liver.

The operation of abdominal section has been also performed by Dr. Marion Sims, Mr. Lawson Tait, Dr. Rausohoff, myself, and other operators[3] on account of various affections of the liver, viz. impacted gallstones, hydatids, and abscess. In many of these cases success has been obtained; but the diagnosis is usually very uncertain. In my own case, which turned out to be one of impacted gallstones, the mobility of the gall-bladder and the absence of the usual symptoms of gallstone led to the belief that it was a cystic tumour. In Dr. Rausohoff's case the diagnosis had been established before operation. There is no need to give any special directions for the operation, which is to be conducted on the same rules as other abdominal sections. The gall-bladder, or the walls of the hydatid or abscess cavity, must be fixed to the wound before opening it, so as to avoid contamination of the peritoneum. If the impacted stone can be removed and the patient recovers, the resulting sinus can easily be closed. The abscess or hydatid cavities will probably fill up spontaneously.

[1] I have known a case in which this artery was punctured and fatal hæmorrhage produced by a surgeon making a puncture, as he thought, in the middle line, not having noticed that the belly was unequally distended.

[2] Gay, 'Path. Trans.' vol. ii. p. 203.

[3] See 'Syst. of Surg.' 3rd ed. vol. ii. p. 745. Rausohoff in 'New York Med. Record,' September 2, 1882. In a case lately under Mr. Haward's care the supposed collection of gallstones turned out to be an unusually movable tumour, probably malignant, and therefore the operation was abandoned, but without any detriment to the patient.

CHAPTER XXXII.

HERNIA.

THE term hernia is sometimes applied in surgical language to the protrusion of any of the internal parts through their coverings. Thus we have spoken of hernia cerebri, hernia of the lung, &c. But it is far more commonly applied to the protrusion of one of the abdominal viscera through the parietes, and when used alone it is always in this sense. The hernia generally takes place through one of the natural 'rings' in the abdomen—the inguinal, femoral, or umbilical—and the part protruding is generally the bowel (enterocele), or the omentum (epiplocele), or both (entero-epiplocele).[1] I shall first speak of the general characters common to all forms of hernia before speaking of its special anatomical varieties.

A hernia is at first almost always reducible—i.e. the protruding viscera can be passed back into the belly. It consists of a sac, formed of the peritoneum, and its contents. The sac, in most cases, is a new formation—a protrusion of a portion of the peritoneum which naturally ought not to exist; but there are herniæ which protrude into a diverticulum of the peritoneum existing naturally in the fœtal state, which should be closed at birth, but remains, on the contrary, congenitally open. Such herniæ, depending as they do on a congenital condition, are therefore called 'congenital;' not that the hernia itself is necessarily congenital, for in some cases it does not appear till adult life, but that the state which produces it is so. Such are the congenital inguinal and the congenital umbilical hernia. The non-congenital, or acquired, herniæ occur in consequence of a weakness of the abdominal wall at the seat of protrusion, and possibly also in consequence of an elongated state of the mesenteries of the viscera. The pressure of the viscera gradually pushes the peritoneum through the wall of the abdomen, and as it advances it contracts adhesions to the parts covering it; and when it has emerged from the cavity of the abdomen, it swells out into a pear-shaped tumour, the constricted part communicating with the general cavity being its *neck*, the dilated part the *fundus*. At first there is nothing perceptible except a little fulness and weakness of the abdominal wall, with unnatural impulse on coughing. Then there is a distinct tumour, which, however, vanishes at once when the patient lies down, or when pressure is made on it; but when the tumour has become more developed and of larger size more manipulation is necessary to press it back again. The sac of course remains, and the viscera immediately re-protrude when the patient stands up or coughs or exerts himself. A hernia is never transparent, as a hydrocele is; it has almost always an impulse on

Congenital and acquired hernia

General symptoms of hernia.

[1] The contents of a hernia are so generally intestine, omentum, or both, that surgeons think but little of anything else, as forming an object of surgical treatment in a hernial sac. Still, as Mr. Birkett says, 'a part of every abdominal viscus has been occasionally found' in a hernial tumour. One of the most interesting of these rare varieties of hernia is that in which it contains the ovary, of which a large number of cases are now on record, both congenital and acquired. In many of these cases the removal of the protruded ovary is advisable, if it be the seat of pain and cannot be easily reduced. See a paper by Dr. Barnes, read at the 'Med.-Chir. Soc.,' and printed in the 'Ann. Journ. of Obstetrics,' Jan. 1883, and one by Mr. Langton in St. Barth. Hospl. Reports,' vol. xviii.

coughing, which is communicated to it through the contents of the bowels acted on by the muscles of the abdomen, and it is traced up and along the canal leading into the abdomen, and by these signs and its reducibility a hernia is immediately recognised in general. But if the contents of the sac have from any cause become adherent to its interior it ceases to be reducible, and is then called *irreducible* or *incarcerated*; and if, besides this, the herniated viscera are constricted, so that the circulation of the contents of the intestines is suspended, it is said to be *strangulated*.

Each of these conditions is marked by symptoms which it is of great importance clearly to recognise; and when the hernia has lost its reducibility, one of the main diagnostic signs being no longer applicable, such symptoms become valuable evidence of the nature of the tumour. The history also ought in such cases to be carefully investigated, for the fact that the patient has for some time been able to push back the tumour at will, or that the tumour has made its appearance quite suddenly, are very strong proofs that it is a hernia.

Irreducible hernia.

When a hernia is merely irreducible, but not strangulated, the impulse on coughing usually remains, and the neck of the sac can be traced up to its exit from the abdomen. The gurgling of the air in the intestine can often be felt on pressure, for the tumour when irreducible is frequently of large size and contains much bowel; and in such cases there may be perceptible resonance on percussion, which is a valuable diagnostic sign. There is often more or less of obstruction to the passage of matters through the bowel contained in the sac, occasioning constipation and vomiting, a condition bordering on and nearly resembling that of strangulation, but distinguished from it by the absence of those more urgent symptoms now to be described.

Strangulation.

Strangulation is marked by total and usually sudden constipation, urgent vomiting, at first merely of food, then of bile-stained matter, next of the contents of the small intestines, and finally of fæces or of matter more or less closely resembling fæces. There is great distress and pain usually in the tumour, and almost always in the neighbourhood of the umbilicus, frequent, irritable pulse, dry and brown tongue, tympanites, and often considerable tenderness of the abdomen and distress of countenance. As the vomit becomes more and more fæcal the tongue becomes drier, hiccough comes on, and the patient sinks into a state of exhaustion, of which he dies, if unrelieved, usually in from ten days to a fortnight. The tumour when strangulated becomes hard, painful, often inflamed on the surface, loses its impulse more or less entirely according to the tightness of the stricture, and the neck is sometimes so constricted that it can no longer be traced along the abdominal ring. The strangulation, even of the omentum only, produces symptoms identical in kind with those of strangulated bowel, though possibly not so severe, a fact which I find it difficult to account for on purely mechanical principles, especially as the omentum, when exposed in the operation for hernia, is constantly tied tightly, in order to remove portions of it, with complete impunity.[1] A strangulated hernia is generally too tightly

[1] The reality of the occurrence of strangulation in pure epiplocele has been to some extent questioned by Mr. Rushton Parker ('On Abdominal Hernia,' p. 20). He seems to think that the symptoms in these cases, usually described as those of strangulation, depend only on obstruction, and refers them to two causes, viz. either to the dragging of the displaced omentum on the transverse colon, or to peritonitis caused by inflammation of the herniated omentum. In other cases he thinks that a small knuckle of intestine which was strangulated had been reduced before the operation. In examining this point I referred to

bound down to permit of any correct opinion being formed by palpation or percussion as to the nature of its contents.

Inflamed hernia.

Strangulation is to be distinguished from mere incarceration partly by the pain in the sac and around the umbilicus, partly by the greater urgency of the vomiting, partly by the constitutional disturbance which accompanies strangulation; but when, as sometimes happens, the hernia, as well as being incarcerated is also inflamed, the distinction becomes very difficult. If the symptoms of strangulation are not very urgent, but the parts are much inflamed, the hernia often becomes reducible, after the application of leeches to the hernial tumour, with hot baths and free fomentation; and in such conditions the administration of enemata, or even of a purgative, seems often very beneficial.

Gangrene.

A most formidable complication is gangrene of the contents of the tumour, an event which is often preceded by a cessation of the pain which the patient was suffering, with a continuance or increase of the low fever, with dry brown tongue, small wiry pulse, hiccough, and slow sinking into a state of collapse, with cold, livid extremities. The coverings of the tumour are often œdematous and inflamed. When gangrene is suspected no further attempt at reduction by taxis is justifiable. The tumour must be at once laid open and dealt with according to the state in which its contents are found.

Ulceration and perforation of the bowel.

Another almost surely fatal lesion is the ulceration of the bowel in the line of the stricture. Under continued pressure (especially in femoral hernia from the sharp edge of Gimbernat's ligament) the mucous coat of the bowel becomes ulcerated, and this ulceration gradually extends to the serous or outer coat. Thus the fæces may find their way into the peritoneal cavity. No symptoms are known to mark the occurrence of this ulceration. If perforation occurs before operation the fæces almost inevitably find their way into the peritoneal cavity, a catastrophe marked by intense pain in the abdomen, followed by rapid and fatal collapse. In some rare cases the fæces have been encysted in an abscess external to the general cavity of the peritoneum, and the patient has recovered. After operation this perforation sometimes leads to fæcal fistula, which is not necessarily fatal nor even permanent.

Treatment.

The treatment of most cases of hernia is extremely simple, consisting merely in reducing the herniated viscera into the abdomen and keeping them so. The first indication is fulfilled, when necessary, by manipulation, technically called 'the taxis,' the second by the application of a truss. If the hernia does not slip up of itself, or under the patient's own manipulation, it is necessary for the surgeon to reduce it, and it is most important that he should be familiar with the way of doing this and with the signs by which it may be known that it has really been accomplished. It often happens that herniæ of which a portion is irreducible (probably from the adhesion to the sac of a piece of omentum implicating perhaps some of the bowel) are

the records of strangulated hernia at St. George's Hospital, and found that out of 150 consecutive cases of herniotomy there had been five in which the sac contained omentum only. In one (umbilical) the symptoms might possibly have been only those of obstruction, in a second the hernia was no doubt inflamed, though it does not on that account follow that it was not strangulated. In the other three (all femoral) I believe the symptoms to have been due purely to the strangulation of the omentum, and I see no *mechanical* explanation of them. Possibly in these cases the action of the bowels is suspended by some inhibitory influence reflected from the nerves of the strangulated omentum to those of the intestines. The irritation of a stricture might set up such a reflex action when the total destruction of the nervous action by a stout ligature would not. See a letter by me in the 'Lancet,' August 4, 1883.

diminished in size by the reduction of the rest of their contents; and the irreducible part being overlooked, a truss is applied which cannot be worn on account of the pain it produces, or which aggravates the mischief by pressure causing increased adhesion. A still graver error is when the surgeon, in applying taxis for a strangulated hernia, forces a small tumour somewhat higher up the canal and leaves it still strangulated in the abdominal parietes, thinking all the time he has reduced it.

The taxis.

In applying the taxis the surgeon should keep in mind the causes which oppose reduction. They are the tension of the abdominal rings, the sudden increase in the bulk of the contents of the herniated bowel, the implication, or folding in, of the contents into each other, and adhesions between the contents, or of the contents to the sac. The latter is of course insuperable, except by a cutting operation.

In order to obviate the tension of the rings the patient is to be placed in such a position that the abdominal parietes may be relaxed, by bending the thigh on the abdomen and adducting it a little so as to relax Poupart's ligament and the fibrous structures connected with it. This may be done by an assistant or nurse.[1] Then the sac is to be gently drawn downwards, so as to unfold its contents as far as practicable, and to enable the pressure to act directly towards the ring. This being done with the

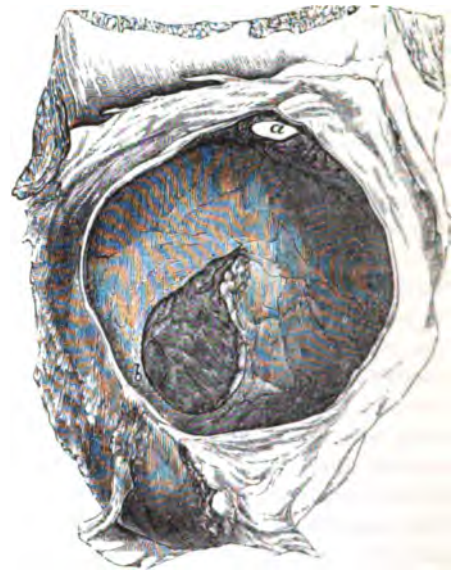


FIG. 290. The sac of a large congenital hernia, showing rupture of the sac by forcible taxis. The hernia had been operated on fifteen years previously. It descended again four days before the patient's admission, and was reduced, but appeared again next day, when forcible taxis was unsuccessfully used. On his admission the scrotum was purple from extravasation. The operation was performed at once, but he died next day from peritonitis. The sac was found to have been torn, and was full of coagulated blood; the mesentery of the herniated bowel had also been lacerated.
a shows the opening made at the operation. The testicle is situated near this opening, but is not visible in this aspect of the preparation.
b shows the rent in the sac extending into the cellular tissue of the scrotum.—St. George's Hospital Museum, Ser. ix. No. 93.



FIG. 291. The gut, with its mesentery, from the same preparation as last figure, showing a rent (*a*) in the portion of mesentery connected with the attached border of the gut.—St. George's Hospital Museum, Ser. ix. No. 96.

[1] Some surgeons believe that an advantage is gained by inverting the position of the body, the pelvis being raised more or less above the head. There is no objection to making a trial in this position if those in the usual one have failed, but it does not seem that much importance is to be attached to it.

fingers of the left hand, gentle pressure is made with those of the right on the more prominent part of the tumour, so as to empty if possible some of the air or fluid in the gut into the abdominal cavity. When this has been done the contents, so reduced in bulk, generally yield easily to the kneading movement which is now gently applied to the hernia, and the protruded viscera return into the peritoneal cavity. This return takes place in a very characteristic manner. The hernia does not recede gradually, but it vanishes at once, generally with a perceptible snap, or with a gurgle of air and fluid; and if there remains on the mind of the surgeon the least doubt whether reduction is complete, he should not be satisfied without putting his finger fairly through the ring, and ascertaining by a comparison of the two sides that no unnatural fulness is left.

Dangers of too forcible taxis.

The process of reduction is materially facilitated by anæsthesia, which neutralises the resistance that the patient can otherwise hardly help making when there is any serious difficulty, and accordingly a hernia should not be regarded as irreducible until the taxis has been tried under anæsthesia. It is a very grave and often fatal error to use too much force in applying the taxis. Our hospital museums contain a ghastly array of preparations showing the bowel or its mesentery or the hernial sac ruptured by forcible taxis, and we have only too frequent opportunities in operating for hernia of seeing the traces of minor violence in extravasation on the bowel or omentum, bloody fluid in the sac, and other lesions, which though not, perhaps, in themselves fatal, yet add to the dangers of the case, and increase the inflammation set up by the state of the parts.

Question of repetition of the taxis.

If reduction has failed it must be left to the discretion of the surgeon whether to repeat it or no, looking at the symptoms of the case and the nature of the tumour. There are some herniæ where the constriction is so very tight that the surgeon at once feels convinced that nothing except the division of the stricture can avail to reduce the hernia; and there are some cases in which the symptoms when first seen are so urgent that even a single application of the taxis would be improper, since the bowel may be gangrenous or so nearly perforated by ulceration that the least pressure would rupture it. In either case the operation must be performed at once. But the indications are usually less clear, and it is difficult to lay down any general rule, as to when the repetition of the taxis is inadmissible, which shall not be liable to frequent exceptions. The one which appears the best, and which is, I believe, usually adopted in the hospitals of this city, is this: when symptoms of strangulation are decided and the vomit is beginning to be tinged with the contents of the small intestine (i.e. is turning from mere bilious fluid to a dark colour and somewhat offensive odour), do not put off the operation longer, after a final gentle trial under anæsthesia. The means which used formerly to be employed in order to facilitate reduction, such as the warm bath, tobacco enemata and bleeding, are no longer used, being superseded by anæsthetics.[1] But in voluminous herniæ, in which the symptoms of strangulation are mild, or which are merely irreducible, the application of ice appears to be serviceable.

Irreducible hernia sometimes becomes reducible after prolonged rest in

[1] I am speaking here of the practice which is pursued at the hospital to which I am myself attached. But the warm bath is used at other institutions. Sir J. Paget lays much stress on its employment, and says that 'it should be used in all cases which are not very bad, unless in old and feeble persons, whom it would depress too much, and in whom fomentations or hot poultices should be substituted;' and he adds that in many cases where the warm bath does not make the hernia reducible at once, it becomes so a little later, when the patient has had a few hours' rest in bed.—'Clin. Lectures,' p. 119.

Treatment of irreducible hernia.

bed, in aid of which saline purgatives appear valuable. Mr. Langton, in an interesting paper in the second volume of the St. Bartholomew's Hospital Reports, points out how much benefit may be obtained in such cases as have resisted the above treatment by constant and well-graduated pressure. This is effected by an 'accurately fitting bag which should be capable of being laced tightly by means of a running tape, so as to follow the decreasing size of the protrusion. The bag may be supported by a cup-shaped truss, or a ball-and-socket truss may be placed over the neck of the tumour, and the taxis may be employed occasionally, as the size of the tumour lessens.' Pure epiploceles may of course be treated more freely than those tumours which contain intestine. For further details and for some interesting examples of the success of the treatment the reader is referred to Mr. Langton's paper.

Accidents in taxis.

The chief accidents which are known to take place in taxis are rupture of the bowel and 'reduction *en masse*.' The minor lesions above alluded to, of bruising, &c., may be suspected when injudicious violence has been used, but can hardly be recognised. 'The indications of burst bowel,' says Mr. Birkett,[1]



FIG. 292. Diagram of reduction *en masse*. The whole sac and its contents (*b*) separated from the parts investing it, and pushed up into the cellular tissue; the gut still strangulated at the neck of the sac (*a*).

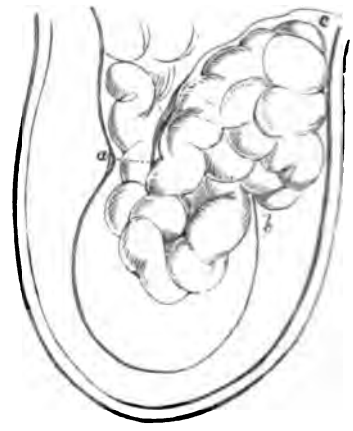


FIG. 293. Reduction *en masse*. The hernial sac torn at *b*, and the bowel (*c*) pushed through the rent into the subperitoneal tissue, but still strangulated at *a*, the neck of the sac.

'are very characteristic. The hernia glides away from the pressure of the finger, and consequently the tumour disappears. This is not, however, accompanied with that sudden and peculiar sensation which the replacement of an unburst bowel within the peritoneal cavity produces. The patient immediately complains of some pain in the abdominal region; vomiting ceases, but pain and hiccough may arise instead; collapse rapidly supervenes, and death closes the scene in a few hours.' Mr. Birkett, however, adds that in rare cases the ruptured part has been closed off from the general peritoneal cavity by inflammation, abscess has ensued, and the patient has recovered with an artificial anus.

Reduction *en masse*.

'Reduction *en masse*,' or '*en bloc*,' is the term which is used to describe the accident in which the hernia is pushed away from the external surface of the body, and nothing is left perceptible except an ill-defined fulness in the canal, but the strangulation is not liberated. It seems that this may be effected in

[1] 'Syst. of Surg.' 3rd ed. vol. ii. p. 777.

at least two ways: 1. The old idea was that in these cases the whole of the sac (neck and fundus) had been detached from the tissues around it and pushed into the canal, or even through the canal into the subperitoneal tissue, leaving the gut still strangulated by the neck of the sac. That this does occur in some cases there is anatomical evidence.[1] (Fig. 292.) But it appears to be more common for the sac to be lacerated, although in these cases its neck may also be displaced and separated from its cellular connections. The laceration sometimes involves the whole sac, in which case the neck of the sac constricting the gut is pushed up the canal and lies in the subperitoneal tissue. Or the posterior part of the sac may be lacerated, and the gut—still constricted by the neck of the sac, or the tissues around it—may be pushed through the rent and doubled up in the subperitoneal tissue under the upper part of the sac.[2] (Fig. 293.)

The accident appears to be not very uncommon when much violence is used. Its occurrence should always be suspected when, after forcible taxis, the symptoms are not relieved, and the surgeon may be almost certain that it has occurred when there has not been the usual characteristic sensation of the reduction of bowel (which I have called above a 'snap'), and especially if some ill-defined fulness is still left on that side of the abdomen, yet the still graver symptoms enumerated above as characteristic of rupture of the bowel are not present. The accident occurs both in femoral and inguinal hernia, but seems more liable to happen in the latter, probably on account of the greater length of the sac. Its treatment should be by immediate operation, as will be more fully described in the section treating of HERNIOTOMY.

Trusses.

In all cases in which a patient is discovered to be ruptured, after the hernia is fairly reduced he should not be allowed to resume his ordinary



FIG. 294. Right inguinal truss.



FIG. 295. Left inguinal truss.

avocations without a truss. If the hernia has been strangulated he should not even be permitted to walk to the instrument-maker's shop without having the reprotrusion of the hernia prevented by a carefully adjusted pad and bandage. In no case of reducible hernia should the continual support of a truss be omitted. An impression prevails that an infant may be too young

[1] See especially the cases related by Mr. Avery, in the 'Path. Soc. Trans.' vol. iii. p. 97, and by Mr. Bryant in his work on the 'Practice of Surgery,' 2nd ed. vol. i. p. 627. Both were cases of femoral hernia.

[2] See Dr. Broadbent's case, 'Path. Soc. Trans.' vol. xii. p. 97; Mr. Morris's, ibid., vol. xxii. p. 148; Birkett, 'Syst. of Surg.' vol. ii. p. 781, 3rd ed.

to wear a truss; but no error can be more unfortunate. It is true that in young infants there is much more difficulty in adjusting a truss, and in keeping it worn without ulceration of the skin, inasmuch as the child is in constant motion, and the truss will be constantly fouled with urine and fæces. The parent or nurse should, therefore, be provided with more than one well-fitting truss, which should be covered with oiled silk and changed when necessary; and all possible care should be given to see that the truss fits, and to pad it with cotton-wool wherever it threatens to chafe. But so far from letting an infant with hernia dispense with a truss, it should, on the contrary, be worn night and day. For the hernia is usually of the congenital form, and the ring will probably close, if the gut be kept out of it,[1] to which end the nurse should be instructed to keep her finger applied carefully to the ring even while washing the child.

A single truss is a spring surrounding the abdomen just below the spines of the ilia, terminating at one end in a pad and at the other in a strap with buttonholes. A button is attached on the back of the pad to which the strap is secured, and the truss is prevented from displacement upwards by a strap fastened to its back part, brought under the thigh, and also buttoned on the pad (Figs. 294, 295). If the ring is very large a tail-piece is attached to the pad, to make pressure over a larger area (Fig. 296). When there is hernia on both sides the spring has a pad at each end, and they are kept in position by a strap passing from one to the other (Fig. 297). The essential requisites of a good truss are that it should fit easily round the body, that its pressure should be directed properly, and should be great enough to prevent the descent of the hernia without being so great as either to be painful to the patient or to cause absorption of the parietes, whereby the ring would be further weakened.



FIG. 296. Left scrotal truss.

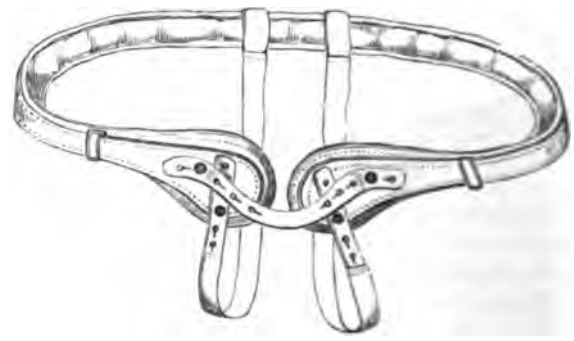


FIG. 297. Double inguinal truss.

Except in the case of infants the truss is only to be worn in the daytime, though, if the hernia descends very readily, the patient may be instructed to apply it before he gets up.

[1] Opinions seem to differ as to the *probability* of the cure of a hernia by the pressure exercised by a truss on the ring, but no one questions its *possibility*; and as to its occasional occurrence, at any rate in early life, I think I can testify from my own experience.

The object of a truss is to exert such an amount of pressure upon the ring through which the hernia has descended that its renewed descent shall be prevented in all positions of the body, and during any exertion which the patient may make. For the attainment of this object it is, of course, necessary, in the first place, that the hernia should be completely reduced. This essential precaution is too often neglected by ignorant persons, and it is, therefore, the surgeon's duty to explain fully to the patient how important it is to make sure of the complete reduction of the hernia before he applies the truss, and also to show him the signs by which he may make sure that the hernia is really reduced. The next point to which attention should be paid is the choice of the form of truss which is to be recommended for the special case in hand. It would be highly undesirable, as well as unnecessary, to speak in this place of the inventions of different instrument-makers or surgeons. Each has its own advantages, when constructed on sound mechanical principles, but those in common use and of cheaper construction answer all ordinary purposes well enough. They may be divided into three classes: 1. Those in which the pad which covers the hernial aperture is supported and kept in place by a spring surrounding the pelvis. 2. Those in which the pad is kept in place by counter-pressure applied to the loins. 3. Those in which the pad is supported on a lever-spring attached to a soft girth or belt.

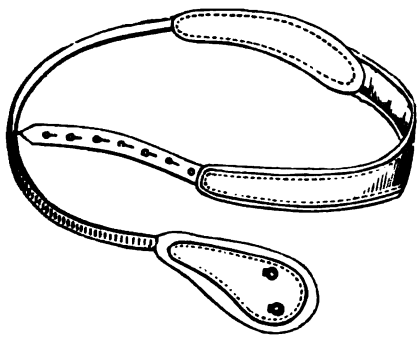


Fig. 298. Spiral spring truss.

The common truss is the best example of the first class (Figs. 294–297). The spring encircles the whole body just below the hips, i.e. the iliac spines, and is prevented from 'riding' or slipping upwards by a strap passing from back to front between the thighs, which is buttoned on to the pad in front. If there is a double rupture, both ends of the spring carry a pad, and both pads are secured by a strap, besides being attached to each other (Fig. 297).

In the spiral-spring truss (Fig. 298) the pad has a spiral spring coiled in it, and the body spring does not encircle the pelvis but terminates in a larger pad on the loins, in which also a spiral spring is coiled, and which is attached to the pad by a strap passing round the sound side of the body. In the double truss the two pads are buttoned together, and the two back pads are hinged together or made into one elliptical hinged piece.

The ball-and-socket truss (Figs. 299, 300, or Salmon and Ody's) is a modification of this, in which the pad is mounted on a ball-and-socket, or universal joint, and in the single form the spring encircles the sound side of the body, crossing in front of the pubes, so as to direct the pressure of the pad up the inguinal canal.

The moc-main lever truss (Fig. 301) derives its peculiar designation from the Indian name of the silk-cotton tree, from the pith of which its pad is formed. But the main peculiarity of its construction is that all encircling springs are dispensed with. A soft belt encircles the body, and to this the pad is attached, carrying a horizontal lever-spring which passes across to the opposite end of the belt. It is comfortable, but cannot be trusted to when anything like forcible pressure is required.

In applying a truss the first thing is to take an accurate measurement of the patient's body by a tape carried from the centre of the hernial opening to the point just below the anterior superior spine on that side, thence horizontally round the back to the same point on the opposite side, and so back to the starting-point. The length of the horizontal line which joins the two anterior superior spines in front, and the vertical distance of the centre of the hernial

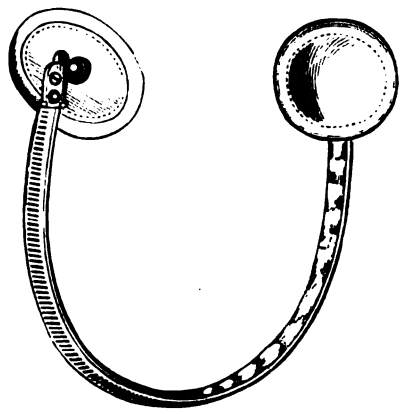


FIG. 299. Ball-and-socket truss. (Salmon and Ody.)

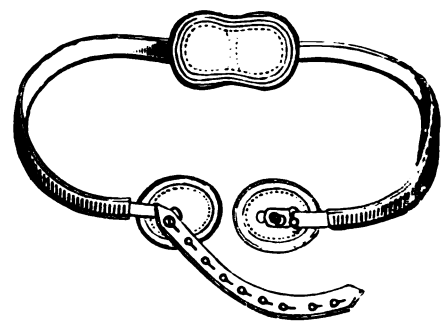


FIG. 300. Double truss.—(Salmon and Ody.)

opening from that line should also be noted, and if the patient is unusually fat, so that the abdominal parietes are very oblique, it is desirable, as Mr. Wood suggests,[1] to note the horizontal distance of the hernial aperture from a plumb-line, let fall from the line which joins the anterior superior spines. In city-practice all this is left to the instrument-maker, but the surgeon ought himself to see that the truss which has been supplied answers its purpose in all respects.



FIG. 301. Moc-main lever truss.

The following are the main qualities of a good truss: 1. It should lie comfortably in the hollow between the buttock and loins, and should be so closely applied to the hips as not to shift in the movements of the patient's body, yet the spring should not be so tight as to gall the skin, nor should the end of the spring project against the wall of the belly. 2. Its pad should cover the whole hernial aperture and the abdominal wall for at least half an inch around it. In large scrotal herniæ a tail-piece to the pad is almost essential in order to prevent the hernia from slipping down under the lower end of the pad (Fig. 296). 3. The pressure should be sufficient to prevent

[1] A paper by Mr. J. Wood on this subject, in the 'Brit. Med. Journal,' Oct. 14, 1871, will well repay attentive perusal.

the descent of the rupture in any exertion which the patient may be called on to make, but should not be so severe as to cause the absorption of the abdominal wall and so enlarge the aperture of the hernia. Certain it is that many patients notice the hernia get gradually larger as the truss is worn, and find that the pad has to be gradually increased in size in order to keep up the rupture. Mr. Wood attributes this to the shape of the pad, which is generally made convex, and for that purpose prefers flat pads, believing that the convex pads press the structures inwards which support the abdominal wall behind, and so destroy their valve-like arrangement. This may fairly be doubted, and it seems to me that the convex shape of the pad is really better, since it buries itself in the skin and fat (beyond which no effect, I think, is produced by the shape of the surface), taking a better hold of the parts, and so saving force in the spring. But whatever shape of pad is adopted it ought to be supported with the least force possible, in order to prevent the escape of the rupture, otherwise not only will its application be irksome, but the ring will certainly be enlarged. As it is almost impossible to calculate the variations which may be occasioned in the outward pressure of the rupture by the patient's circumstances, those who are liable to be called on for extra exertions at stated times are sometimes usefully provided with two trusses, one for rest, the other for exercise.[1] An instrument has been devised by Mr. Wood for the purpose of measuring the resistance of a rupture.

Finally, the direction in which the pressure is made must correspond to that of the hernial canal. Direct inguinal hernia comes straight forward out of the belly, and its neck is very short. Oblique inguinal hernia, on the contrary (unless it has been long neglected, in which case the neck is shortened and the enlarged rings are brought almost into a line, giving it much resemblance to the direct form), has a long neck running obliquely upwards and outwards, and the pressure must be made in this direction and in such a manner that the pad may bring the walls of the spermatic canal into contact and press on the situation of the internal inguinal ring. Femoral hernia, again, has a short neck terminating at a ring which in the erect position is nearly horizontal, so that the pressure is most effectively directed upwards, bringing the pad to bear directly on Gimbernat's ligament. If the rupture has been operated on, the corresponding ring is often enlarged and weakened, and more than common attention must be bestowed to see that the pad is large enough and makes pressure in the proper direction.

The above has reference to inguinal and femoral ruptures only. Umbilical and ventral herniæ are treated by a belt round the abdomen, the belt being laced behind, and provided with elastic sides. This belt carries a pad corresponding to the position of the hernial opening, and so made that its surface is accurately adapted to the shape of the wall of the belly, and its outline overlaps the opening on all sides. The common practice in umbilical rupture in childhood of putting a nipple-shaped pad *into* the orifice seems to me bad, as tending to dilate the opening: at the same time the tendency to natural cure is so great that as a rule no harm follows.

'Radical cure' of hernia.

The wearing of a truss may, as has been said above, prove curative, but this is certainly exceptional. On the other hand, there are cases in which the ring is so large that there is much difficulty in applying a truss; and in all cases a hernia is a grave infirmity, and exposes the patient to constant danger.

[1] Persons who are addicted to swimming must have a special truss for the purpose, covered with indiarubber material.

This danger, however, is extremely slight, if proper care be given to the management of the truss. The chief inconvenience of an ordinary reducible hernia is that it debars the patient from the safe or comfortable pursuit of various athletic sports, and that it constitutes a bar to his entrance into the public services.

For one or other of these reasons the patient often seeks for a radical cure, and many have been the operations proposed for this object. And I think it may be said of all of them, even those most recently devised and most carefully thought over, that they usually fail in their object, unless assisted by the pressure of the truss, that is to say, that they are not really 'radical cures,' as they are generally called. Nor is this surprising. The object of the operation is to close the abdominal ring. Now, this can only be effected in umbilical hernia, for in inguinal hernia an attempt absolutely to close the ring would certainly involve the scrotal cord, and in femoral hernia the femoral vein. In femoral hernia, however, the operation is, I believe, too dangerous to be justifiable. One fatal case attracted some attention a few years since, in which the bowel was perforated in an attempt to close the femoral ring, and I am not aware that the operation has been repeated. In umbilical hernia the radical cure is rarely attempted, since the congenital form usually disappears in after-life, and the acquired form occurs generally in elderly stout people, who are not fit subjects for surgical operation nor given to active pursuits, and the local conditions are also usually very unfavourable. The operation is, therefore, in practice, restricted to inguinal herniæ in the male sex, and I think it ought never to be performed except upon patients who (either themselves or their parents) have been properly informed of its dangers, and who deliberately choose to incur them in order to get quit of the inconvenience. The methods of Wützer and others, though much vaunted at the time, are now, I believe, admitted to be nearly universally failures.

Wood's operation.

In Mr. John Wood's operation an assistant reduces the hernia, and keeps it most carefully reduced the whole time, keeping two fingers pressed above the internal ring, so that there may be no chance of the operator's needle injuring the gut. The instruments required are a stout unyielding needle, in a handle with a peculiar curve adapted to the shape of the finger, and a piece of stout copper wire silvered, about two feet long. Great care must be taken to see that the wire is properly flexible and free from kink. An incision is made through the skin of the scrotum, about an inch long, so as to expose the fascia covering the hernial sac. The skin and fascia are then separated for about an inch all round the aperture. The finger is pushed up along the face of the cord, pushing the fascia and sac in front of it until it is fairly within the spermatic canal and feels the internal pillar of the internal abdominal ring; the conjoined tendon is then recognised and carefully taken up on the needle, which is then made to traverse the superficial parts obliquely, upwards and inwards. The skin is now drawn upwards and inwards, and the needle is pushed through it. One end of the wire is then hooked into the needle's eye and the latter is withdrawn, carrying the wire along with it. Then the needle is disengaged from the wire and carried again along the finger to the outer side of the ring; here it is thrust through the tissues at the outer side of the internal aperture of the hernia ('the anterior aponeurosis, close to Poupart's ligament,' as Mr. Wood describes it), and then the skin is brought over so that the needle emerges at the former puncture. The other end of the wire is now hooked into the needle's eye, and the latter is withdrawn and disengaged, leaving a loop of wire emerging from the skin of the groin, and two ends which embrace more or less completely the internal orifice of the hernial sac. The next

step is to pinch up the hernial sac and the fascia covering it, between the finger and thumb, opposite the scrotal opening of the hernia, the spermatic cord being slipped away from their grasp as in the operation for varicocele. The needle is then made to take up all the tissues which lie in front of the cord i.e. the whole circumference of the external ring and its neighbourhood), and it is made to enter and emerge from either corner of the scrotal wound. The extensibility of the scrotal tissues renders this generally easy. One end of the wire (either end will do, but Mr. Wood prefers that which has been passed through the conjoined tendon, i.e. inside the internal ring) is then hooked into the eye of the needle and brought down. Thus, one of the ends of wire is left possibly lying behind, but, as Mr. Wood points out, more probably in most cases passing through the tissues of the sac, and embracing its lower orifice, while the other end simply traverses the inguinal canal and one of the pillars of the internal ring. The two ends are now drawn down, straightened and stretched till the loop comes close to the skin, where it is held by an assistant, while the surgeon twists together the two ends (counting the number of twists which he gives, in order that he may know how to untwist them afterwards), and by this twisting the tissues around the external ring are, of course, twisted along with the wire. Now the loop is drawn forcibly upwards, so as to invaginate these twisted tissues firmly into the inguinal canal. Then the two ends of the loop are twisted a certain number of times, so as to have a firmly-twisted stalk, but with still a loop at its end; and finally, the two free ends of the wire are passed through this loop and made fast around a pad of lint which presses over the inguinal canal. The patient is placed in bed, with the testicles supported and the abdominal parietes relaxed. The wire is generally left till about the eighth or tenth day, when it is untwisted, and is removed about the fourteenth. Suppuration usually lasts for some time in the track of the wires. The operation for inguinal hernia in the female is exactly the same in principle, but is very rarely performed.

The patient must not leave his bed till the parts are sufficiently consolidated to bear a pad and bandage, and must wear a truss afterwards.

Other methods of radical cure.

The above operation has not, I think, got into general use, for although its occasional success cannot be doubted, yet there is equally no doubt that it often fails, and that it is not free from serious danger. Two other methods are now pretty extensively tried. One, devised by Mr. Spanton of Hanley, consists in the application of a kind of corkscrew instrument (described in the 'Brit. Med. Journ.' Dec. 11, 25, 1880, and Jan. 8, 1881), which is insinuated into the tissues on both sides of the inguinal canal, after the reduction of the hernia, and left there for about a week until the parts are supposed to be quite consolidated, when it is withdrawn. Mr. Spanton, in his latest paper on the subject ('Brit. Med. Journ.' July 22, 1882), states that he had then operated on thirty-four cases, and that of these 'thirty are known to be more or less completely cured;' and in a postscript he brings the total up to fifty-one, of whom none had died. The evidence as to the proportion and permanence of the cure is no doubt incomplete; but the proceeding seems a simple one, and worthy of further trial.

Another method is to dissect the sac clear of all surrounding tissues, open it, and see that it is free of any contents, or, if there be any adherent omentum, tie and remove it; then pass two stout carbolised gut ligatures round the neck of the sac, and finally sew the pillars of the ring together with silver sutures, which are left buried in the tissues. Mr. Mitchell Banks of Liverpool

described this method in 'Brit. Med. Journ.' Nov. 18, 1882, and relates the particulars of thirty cases, in nine of which, however, it was a part of the operation for strangulated hernia. Mr. Banks's operation is no doubt more severe and dangerous than Mr. Spanton's, but it seems more certain, is applicable to all forms of hernia (while Mr. Spanton's only applies to the inguinal), and can be applied in irreducible and strangulated herniæ. Mr. Rushton Parker has also recorded several operations of this kind (op. cit. p. 39).

Herniotomy.

The operation for strangulated hernia (called sometimes Herniotomy or Kelotomy) differs but slightly in the different forms of hernia. In many particulars it is the same in all forms.

The only special instruments required in an operation for hernia, besides the ordinary contents of the pocket-case, and an extra pair of forceps with a very fine bite, are the hernia-knife and hernia-director. The knife has a probe-point, and only a very short cutting edge, so as to endanger the bowel as little as possible. It is made either straight or curved, the latter being the most convenient shape for deep-seated constrictions. The hernia-director as usually made is merely a common director much broader than usual. The object of this breadth is to push away the bowel from the edge of the knife when the latter is passed under the stricture. Sometimes the director is provided with wings for the same purpose. It is also advisable to have a stout double ligature ready on a curved needle in any case where the sac may contain much omentum.



Fig. 302. Hernia-knife.

Extra-peritoneal operation.

A free incision is made over the tumour by pinching up a fold of skin and subcutaneous tissue and dividing it. Then the surgeon cuts down with care on to the sac which invests the hernia. This is usually done by pinching up the successive layers of fascia, making a small hole in them, and dividing them on a director to the extent of the original wound. When the sac is fairly exposed the surgeon may examine the structures around its neck carefully, pass his director under any of them which seem to be constricting the hernia, make a sufficient incision into them with the hernia-knife, and then try to reduce the hernia. This will often succeed when the stricture is entirely external to the sac. The hernia being reduced, the wound is sewn up. But if this attempt has failed, or if, from whatever cause, the surgeon is unwilling to try it, the sac is next to be divided. This should be done with all imaginable care. If the tension is not very great it is better to pinch up a fold and divide it with the edge of the knife turned horizontally, so as not to endanger the gut, much in the same way as the sheath of an artery is opened. When the sac is too tense to permit this it must be gently scratched through till the fluid or gut underneath is reached. In the great majority of cases there is some fluid in the sac, the escape of which gives conclusive proof that the sac has been opened, but in some instances the gut and the sac are completely in apposition, and if the greatest care be not used, the bowel may be wounded, as has often happened. The little hole in the sac is enlarged on a director freely enough to allow a complete view of the whole contents of the sac. The surgeon passes his finger along the gut or omentum to the ring, and then feels the stricture with his nail. He carries the hernia-director along his nail under the stricture, and then insinuates the cutting edge of the

hernia-knife beneath the constricting band, and divides it to a very slight extent. If this does not allow the easy reduction of the hernia, another little nick must be made in the same or another part of the stricture, so that the bowel can be reduced without dangerous violence. Finally, the reality of the reduction must be put beyond doubt by passing the finger through into the peritoneal cavity, and then the wound is to be sewn up and a pad and bandage applied.

Every step in the operation thus summarily described has its own difficulties and dangers, and presents many points for observation. I will try briefly to indicate those which are most important.

In the first place, with reference to cutting down upon the sac. It is a matter of great consequence for the rapid and satisfactory performance of the operation to be able clearly to recognise the sac from the membranes which surround it, nor is this at all easy. The subperitoneal fat often so closely resembles the omentum that the operator is tempted to think that he has opened the sac without knowing it. But on trying to pass his finger round the supposed omentum and up into the peritoneal ring, he will find that he cannot do so, and the error will be manifest. Much time is sometimes lost in carefully dealing with membranes taken for the sac which are merely the investing fasciæ or the membraniform layers of the common cellular tissue. But the sac is usually recognised by its more distinctly fibrous appearance, and by the colour of the fluid which is seen through it.

Comparison of the extra- and intra-peritoneal operations.

The parts constricting the hernia external to the sac are usually very perceptible when the operation without incision of the sac is indicated, and in ordinary cases of strangulation I can see no motive for exposing the peritoneal cavity. It is true that the statistics of the two operations do not show any such striking differences in rate of mortality as to be decisive of the question; for allowing, as Mr. Bryant's[1] figures show, that the death rate is lower after the operation performed external to the sac, yet it seems probable if not certain that the cases were more favourable, as indeed Mr. Bryant points out. But common sense (which I hold to be a better guide than statistics) appears to me to be in favour of leaving the sac untouched if possible. A surgeon attempts to reduce a hernia by taxis; failing this, he thinks it necessary to operate. If he could reduce the hernia without cutting the skin he would be well pleased, for experience will have taught him that death is excessively rare after successful taxis. Surely, then, we may argue, if it could be conceived that the mere division of the skin could make the hernia reducible he would not incise the deeper parts; if the mere division of superficial bands of fascia would make it reducible he would not expose the sac. Similarly, if the division of the constriction above the sac enables him to reduce the hernia, why should he open the peritoneum? The only conceivable motive is in order to obtain a view of the hernial contents, in case it should prove unadvisable to attempt their reduction, and therefore it may be admitted that in cases where the taxis is contra-indicated (see p. 635) the sac should always be opened at once. And, of course, if no constriction can be found external to the sac, and the surgeon is clear that the neck of the sack forms the stricture, no good can be done (and some harm perhaps may) by trying in vain to reduce the gut after having divided some structures which are not really on the stretch. But when any definite stricture external to the sac can be made out it should be incised. I have often reduced herniæ by this operation,[2] and have never had to regret it.

[1] 'Practice of Surgery,' 2nd ed. vol. i. p. 620.

[2] 'I may perhaps mention that an erroneous idea prevails that the operation external to

Seat of stricture.

The seat of stricture varies much for different kinds of hernia. In those forms (as the femoral) which are surrounded by very tight fibrous structures, these are very liable to be the agents, or at least the chief agents, of constriction, while in other cases the sac itself is alone concerned in producing the strangulation, which will last even when the sac and its contents have been liberated from all the surrounding parts, as in reduction *en masse*. This is partly illustrated by the accompanying case and drawing. In such cases it is evident that the constriction cannot be relieved without opening the sac, and in many cases where the main agent of strangulation is anatomically external to the sac, such as the deep crural arch or Gimbernat's ligament in femoral hernia, yet it has become so buried in and incorporated with the neck of the sac that practically it is impossible to divide it external to the tumour.



FIG. 303. Strangulation of a hernial tumour by the neck of the sac, at the internal abdominal ring. This preparation was taken from the body of a patient who was admitted with a strangulated hernia the size of a man's fist. Attempts at reduction were made in vain; then the patient was put into a warm bath, and fresh attempts were no doubt made, as the tumour suddenly disappeared, although at the time the hernia was said to have disappeared without being touched. The man died six and a half hours afterwards, unoperated on. The hernial tumour was found to be entirely within the inguinal canal, the external ring being quite free.

Inspection of contents of sac.

When the sac is opened the nature of the fluid which it contains should be noticed, in respect of prognosis. If it be merely thin serum it is so far favourable. Flakes of lymph speak of commencing inflammation of the bowel;[1] blood, of bruising by taxis or unusual congestion from tight stricture; a dark, sanious, fœtid condition, of commencing gangrene; and bubbles of gas, of perforation of the bowel, which, if not gangrenous, is ruptured or ulcerated, and should be carefully examined in order to detect the spot.

Now the stricture being divided, the condition of the sac and of the hernia absorbs the most careful attention of the operator. If there is both omentum and gut in the sac the first point will be so to disengage them from each other that the latter can be separately returned. In some cases the whole sac is closely lined with omentum, and when this is the case there is the strongest reason for apprehending that it is a case of what Sir P. Hewett has so well described as 'an omental sac,' in which the bowel descends into the centre of a mass of omentum, and is constricted within the sac so formed by the thickening of the tissue at its neck. This may happen in any form of hernia, though it is most common, I think, in the umbilical. In such cases the omentum must be carefully torn or scratched through until the bowel is found inside, when the finger must be passed along the bowel, the

Omental sac.

the sac is not practised at St. George's Hospital. Possibly we may not form so high an opinion of its advantages as some do, and may not therefore attempt it so frequently, but it is certainly used in all the cases which seem to the operator appropriate. The reader may refer to Sir J. Paget's 'Clin. Lect.' p. 127, and Mr. Howard Marsh's note on that passage, also to a paper by myself in the 2nd vol. of the 'St. George's Hospital Reports,' p. 322, and a clinical lecture in the 'Medical Examiner' for 1877, vol. ii. p. 586.

[1] As a surgical curiosity I may mention the presence of a loose body in the hernial sac, an example of which is related in 'Path. Trans.' vol. xv. p. 96. These loose bodies bear considerable resemblance to the loose cartilages. They are formed by aggregations of lymph and fibroid tissue, often, as it seems, in appendices epiploicæ, which then become detached: sometimes, perhaps, as the result of contusion.

director inserted below the ring of the omentum, and the constriction incised just sufficiently to admit of the return of the bowel. Of course, in so dealing with a vascular structure like the omentum, hæmorrhage may be caused, but unless the omentum be divided the relief of the strangulation is impossible.

Treatment of the strangulated bowel.

The omentum being unravelled, or if necessary divided, the bowel is exposed; or if there be no omentum in the sac the gut comes into view at once, and the surgeon has to decide what to do with it. In all ordinary cases the decision is instantaneous and the gut is reduced at once, for it is important not to expose it to the air a moment longer than is necessary. But it is by no means easy to reduce a large tense mass of bowel even when one has it in one's hands, and much patience and care are necessary to avoid bursting it. In dealing with a large mass of bowel the operator should try to pass one end back at a time (and if the upper end can be distinguished from the lower he had better begin with that) by gently pressing the contents of the bowel into the abdominal cavity and pushing the gut after it with a kneading motion of the two hands. An assistant steadies the rest of the bowel and follows the movements of the surgeon. When once a part of the gut is reduced the rest soon follows. Operators have even found it necessary in cases of extreme distension of the bowels to prick them in one or two places with a needle and evacuate the air from them. As they collapse and the three coats slide on each other the punctures in them no longer correspond, so that no extravasation of fæces follows. But this cannot be necessary except in very rare cases.



Fig. 304. An 'omental sac,' from a case in which the stricture was relieved by operation, the omentum being divided in order to reach the bowel. *a* points to a dense fibrous membrane, apparently a condensation of the different fasciæ and neighbouring areolar tissue; *b*, to the peritoneal sac; *c*, the external surface of the omentum, which is spread out over the interior of the whole of the hernial sac; *d*, the wound made in the operation; *e*, the testicle. This preparation is from one of the cases referred to by Sir P. Hewett in 'Med.-Chir. Trans.' vol. xxviii., and is in the Museum of St. George's Hospital.

If the bowel is found ruptured by previous taxis, or if it gives way during the efforts at reduction, yet is tolerably healthy, the rent should be sewn up with the continuous suture, and the bowel returned,[1] and the same course should be followed in case of an accidental wound or puncture with the knife.

Ulceration in the course of the stricture.

The bowel may be ulcerated at the seat of stricture, though healthy in other parts. This ulceration begins on the mucous surface, and is always seen

[1] For a case in which this was done with perfect success see a paper entitled 'Remarks on two Cases of Strangulated Hernia,' in the 'St. George's Hospital Reports,' vol. iii.

to be more extensive on the inner than the outer face of the bowel, even when it has penetrated all the coats of the gut. It may, therefore, be going on without being at all perceptible externally; and for this reason, and also because traction on the weakened bowel may break it down, while it otherwise might recover, I think the advice generally given to draw the herniated bowel down so as to examine the part constricted and ascertain the absence of such ulceration, is mistaken, and I would only do so if the escape of air shows that perforation has occurred somewhere. The reduction of a bowel in which such ulceration is impending is by no means necessarily fatal. I have seen many cases in which after a few days fæcal fistula has followed, in all probability from this cause, yet the patient has completely recovered. The ulcerated part has been shut off from the general peritoneal cavity by inflammatory effusion before perforation has occurred. These fistulæ sometimes remain permanent, but more frequently contract and ultimately heal.

Fæcal fistula.

Reduction of inflamed bowel.

In all states of inflammatory degeneration short of gangrene I think the counsel given by Aston Key to reduce the bowel into the peritoneal cavity is judicious. It is more likely to recover itself there than if left protruding, and if it does not do so fæcal extravasation into the peritoneal cavity is by no means common. On this subject, however, every operator must follow his own judgment. There is no question that a gangrenous bowel, including one in which gangrene though possibly not present is absolutely commencing, should be left in the sac, the stricture having been freely divided. And it is better, I think, to lay the gut open and attach it round the wound, not because there is any chance of its receding into the belly—for it is glued to the neck of the sac by inflammatory adhesions—but in order that the rest of the wound may be united and a free exit left for fæces at the artificial anus. Some operators cut away the gangrenous part of the bowel and attach the two ends to the wound.[1] Gangrene of the gut, if complete, is unmistakable; its earlier stages are marked by mottled greenish discoloration of the bowel, loss of lustre, and formation of blebs under its serous coat, as well as by the before-mentioned characters of the serum in the sac.

Treatment of strangulated omentum.

The practice of different surgeons differs in dealing with the omentum, when in a morbid state, either from bruising or inflammation. At St. George's Hospital our practice is to surround it at its neck with a stout double ligature and cut it off, leaving the ends of the ligature projecting out of the wound, or with a ligature of carbolised catgut, the ends cut short, and this seems as successful as any other plan. Others prefer simply to leave it in the wound, a plan which has the assumed advantage that the omentum becomes consolidated to the ring and may act as a plug, preventing the return of the hernia; but it has the drawbacks of prolonged suppuration in the unhealthy mass, and possible imperfect closure of the ring, so that instead of being obstructed it may be, on the contrary, kept permanently open. Others again having cut off the omentum tie each vessel which they find bleeding in it. If this plan is adopted it is best to secure the neck with a clamp before cutting the mass away. The objection to it is that vessels which do not show while exposed may bleed on being returned into the abdomen. On the whole, I have seen no reason to try any other than the first method. When the omentum adheres to the sac it should be removed.

If the gut be adherent to the sac it is probable that the adhesions will be too extensive to be separated; at least it has been so in the instances which

[1] Byrd of Ill. in 'Trans. of Am. Med. Assoc.' 1882.

I have seen, and it is necessary to leave the bowel where it is, after dividing the stricture freely. But it is a very unfavourable element in the prognosis.

Operation in case of reduction *en masse*.

In cases of suspected reduction *en masse* the operation is of a much more complicated and difficult character. The external opening must be made very free, and the ring must be clearly exposed. In cases of inguinal hernia an incision is made on a director up the spermatic canal, and the surgeon feels with his finger for the sac or the bowel as the case may be. When this has been found it is, if possible, to be exposed by incision; in any case it must be drawn gently down till the parts are fairly in sight. Then the sac, if unopened, is to be freely incised, and the dissection conducted along the bowel till the seat of stricture is reached and the constricting tissue so fully divided that the finger can be passed along the bowel without resistance into the peritoneal cavity; and not till he is perfectly satisfied that no further constriction exists should the surgeon try to reduce the intestine. In cases of femoral hernia the position of the sac is probably less deep, but care must be taken to avoid injuring the femoral vein.

Radical cure after herniotomy.

The proceeding described by Mr. Mitchell Banks and Mr. Rushton Parker (see page 648) is still more plainly justifiable in operations for strangulated hernia than in cases where no strangulation exists, and numerous surgeons have made more or less deliberate and carefully contrived attempts to obtain a radical cure after herniotomy. The best plan seems to be to strip up the neck of the sac (possibly encircled by more or less of the fascia) till the interior of the abdominal wall is reached, and surround it with two or more stout catgut ligatures, and in inguinal hernia the pillars of the ring may be sewn together, though Mr. Parker regards this as superfluous.

When the operation is completed the wound is to be carefully adjusted and dressed, and then it is usual to put on pressure with pad and bandage. This is perhaps absolutely necessary only when the patient is troubled with cough, in which case the gut might certainly re-protrude; and I have seen it do so even under the pad, requiring the wound to be laid open and the gut reduced afresh. Under ordinary circumstances the bowel would probably remain in place without any special dressing; but the pad does no harm, and gives some support to the wound. It need not be used after the first dressing. The spica bandage is put over the pad, as figured in the chapter on MINOR SURGERY.

After-treatment.

The after-treatment of cases of hernia which go on favourably is generally very simple. No length of constipation is now held to necessitate a resort to purgatives, so long as there are no symptoms calling for their administration. Cases do perfectly well in which the bowels do not act for a fortnight, and even a longer period. And it seems most rational to avoid any disturbance of an intestine which has just undergone so serious an ordeal as exposure and operative reduction involve. Yet the indiscriminate resort to opium and the extreme horror of purgatives which some operators display appear to me unnecessary. Unless there is some special indication from pain or restlessness, or some threatening of peritonitis, I see no reason for administering opium, unless perhaps a single dose or single subcutaneous injection to procure tranquil sleep after the operation. And when the abdomen is becoming distended from constipation much relief will be found from evacuation of the bowels by an enema; or if there is also a foul state of the tongue, by a gentle purgative.

Sequelæ of strangulation.

A few other points deserve notice in speaking of the phenomena of strangulation, and of the operation for its relief. In the first place, I would

observe that although the taxis if successful in wholly reducing the bowel is hardly ever followed by any symptoms whatever (so that the patient is at once restored to his usual health), yet this is not always the case. I have seen two or three cases, in the course of an experience of about a quarter of a century, in which peritonitis has persisted after the reduction of the bowel, and has proved fatal.[1] And a case lately occurred under my care in which after the reduction of the herniated intestine it sloughed, and the patient died about ten days after the reduction with very obscure symptoms, which afterwards were found to depend on gangrene of the bowel formerly contained in the sac without any general peritonitis.

The bowel after strangulation, though neither ulcerated nor gangrenous, is often so inflamed as to be unable to resume its functions at once. Thus, even after the complete reduction of the bowel, constipation and vomiting not unfrequently continue; in fact, constipation without vomiting almost invariably follows strangulation, and is no doubt salutary, as providing rest for the injured intestines. But sometimes it appears as if the bowel were more permanently injured, as it was in the case from which the accompanying figure was taken, in which the bowel which has been strangulated is seen much thickened, narrowed, and obviously incapable of the natural action, and the distension of the bowel above the seat of stricture is considerable. The history shows this to have been the result of the inflammation caused by the stricture.



FIG. 305. Contraction of the bowel after strangulation. The portion which has been in the hernial sac is so contracted that, at the time of examination, water would hardly flow through it. The bowel above is much dilated, that below is of the natural calibre. The contraction is due to induration and thickening of all the coats of the bowel. The patient, a woman, had been operated on for femoral hernia. At the operation the bowel was found considerably inflamed. She went on pretty well for a time, complaining, however, occasionally of griping and constipation. The wound healed, and a truss was fitted about a month after the operation, but the griping and constipation became worse, and about eight weeks after the operation she died quite suddenly, as if from perforation of the bowel. On post-mortem examination, however, no perforation was found, nor any peritonitis, but the bowel was much ulcerated on its mucous surface.—St. George's Hospital Museum, Ser. ix. No. 84c.

Peritonitis after operation.

Peritonitis after the operation for hernia is a very common cause of death, being sometimes connected with inflammation of the bowel; at others with inflammation spreading from the wound. It must be treated by free leeching, if the symptoms are those of the acute form of the disease, viz.: fever, rapid and hard pulse, great pain in the belly, with frequent vomiting and tympanitis. After the leeches bleeding should be encouraged by warm fomentations, and the addition of mercury to the opium which is indicated in all forms of traumatic peritonitis may be useful. The low form of peritonitis is even more fatal, in which there is little pain and a low irritable pulse, with dry brown tongue, the nature of the affection being marked rather by vomiting and tympanitis than by any other more definite symptoms. In such cases the peritoneal cavity will be found filled with purulent serum, and there will most likely be pus diffused among the meshes of the subperitoneal tissue. Here reliance must be placed mainly on opium, stimulants, and fomentations, all depressing measures being avoided; but the treatment is rarely successful.

Artificial anus.

Two different conditions lead to the discharge of fæces from the wound after operation, which ought to be distinguished from each other by appropriate names. They are, however, usually confounded under the common

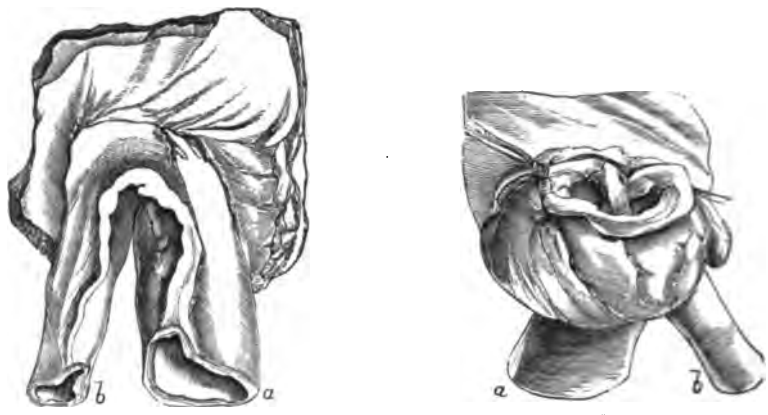
[1] One of these cases is reported in the 'St. George's Hospital Reports,' vol. iii. p. 326.

designation of 'artificial anus,' which is only appropriate to one of them. The one, which should be called *fæcal fistula*, depends on the ulceration of the bowel in the course of the stricture which has been above described. A portion of the fæces passes from the wound, but another portion usually, if not always, is voided by the natural passage. In this case, as the ulceration has made its way from the interior or mucous surface, it has caused a limited inflammation of the serous coat by which the ulcerated portion of the bowel has been glued to the parietal peritoneum coating the wound, the discharge from the bowel is directed externally, and thus extravasation of fæces into the peritoneal cavity is, under ordinary circumstances, prevented. Fæcal fistula.

If this should not be the case profound collapse occurs, speedily followed by death. More commonly, however, there is no very great inconvenience connected with this accident beyond the appearance of fæces in the discharge, an event which may be apprehended when the gut has been seen at the time of operation to be much inflamed, and when (with or without preliminary pain in the wound) the discharge has been noticed to be foul and offensive. I have seen many such cases terminate in complete recovery, the fæces passing by the anus in gradually increasing quantity until the fistula has been soundly healed. Beyond rest in bed and avoidance of constipation I do not know any treatment which can be adopted, nor in cases where the fistula has remained permanent have I ever heard any surgical measures proposed. It would no doubt be possible to cut into the abdominal cavity, and trace the bowel to the adherent part, when the ulcerated opening might be clamped and its edges then refreshed and sewn up; but it would be a very dangerous measure. I am under the impression, however, that such an operation has been performed, though I cannot refer to it. Mr. Parker (op. cit. p. 29) relates a case in which the fæcal fistula was successfully closed by operation, the ulcerated bowel being still in the hernial sac.

But the condition to which the name of artificial anus is appropriate, and to which it should be restricted, is that which is shown by the annexed illustrations. It is caused by gangrene of a considerable portion of the wall of the gut, leading to a state of parts which can only be remedied by a surgical operation. Whilst the gangrenous part of the bowel has been separating, the living portions have been contracting adhesions to the parietal peritoneum, and the bowel, bent at an angle, is found (as in Fig. 306, A) adherent to the wall of the belly all round. The superficial gangrenous portion of the knuckle of intestine having come away, a large orifice is left (as shown in Fig. B), in which the upper and lower coil are seen to open, much like the muzzle of a double-barrelled gun, except that one is larger than the other, especially after a time. For the lower coil of intestine (*b*), as it no longer transmits any fæces, shrinks up and becomes smaller than the upper, sometimes almost obliterated and cord-like. The septum between the two orifices, called by Dupuytren the éperon, or spur, on account of its prominence, is formed by the posterior wall of the intestine at the junction of the two coils, and it is projected forward by the bowels which lie in the receding angle between the two. The angle of junction is generally very acute, and this spur is sometimes of considerable length. It is this projection which diverts the fæces from the upper bowel through the skin-wound and prevents them from passing into the lower part of the bowel. Therefore, so long as this spur remains the condition is incurable, and the first step in the surgical treatment of artificial anus is so far to destroy the éperon as to permit the passage of fæces directly from the upper into the lower bowel. This is effected by the gradual pressure of Dupuytren's entérotôme. One blade being passed

up each of the coils of bowel as high as is deemed necessary, they are connected together and are brought into close contact by means of the screw. This is twisted tighter and tighter as may be necessary until the instrument ulcerates through the walls of both intestines and drops off. While this ulceration is in progress the peritoneal surfaces of the two coils of intestine



A B

FIG. 306. A, the internal, and B, the external, views of a preparation showing the state of parts in artificial anus after an operation for femoral hernia.
In the first figure may be seen the larger size of the coil of intestine (*a*), which is nearer the stomach and has transmitted the fæces, in comparison with that of the lower coil (*b*), the very acute angle at which they join, and the small extent of the union of their internal or peritoneal surfaces. In B may be seen the aspect of the opening on the skin, and the projecting septum (the éperon of Dupuytren), which divides it into two parts, and which must be destroyed, in order that fæcal matter can pass from the upper to the lower part of the bowel. The projection of this septum would doubtless have increased had the patient lived longer. She was pregnant, and died after miscarriage about three weeks from the date of the operation.—St. George's Hospital Museum, Ser. ix. No. 102.

pour out lymph and adhere together all round the portion included in the blades of the entérotôme. This prevents any effusion of fæces into the peritoneal cavity. The contents of the upper bowel (*a*) now pass freely into the lower bowel (*b*) within the peritoneal cavity, the éperon withers away, and the wound contracts. It may possibly heal of itself. If not its edges must be cautiously refreshed and a piece of skin be transplanted into the opening, if the orifice is too large to admit of the edges being brought into direct contact.



FIG. 307. Dupuytren's entérotôme.

The dangers connected with this operation are mainly two. One is that a coil of bowel may lie in the receding angle between the two coils *a* and *b*, Fig. A, and this may be caught or bruised by the entérotôme. To avoid this all imaginable care should be taken to examine well with the two forefingers, in order to make sure that there is nothing except the walls of the two coils of bowel between the blades of the instrument. The other danger is that the adhesions may not form sufficiently, and that the fæces may escape into the peritoneal cavity.

I ought not to quit the subject without adding that there are cases in which the sloughing of a considerable portion of bowel may take place, and yet no permanent artificial anus may result. Thus Mr. Hey relates an instance from Sir

A. Cooper's practice in which the bowel, in an operation for femoral hernia, was found extensively mortified; an incision an inch and a half long was made in it and its contents evacuated. The mortified portion of intestine separated by sloughing, and from the length of the incision it seems certain that it must have comprised the whole circumference of the bowel; yet soon afterwards the fæces passed naturally and the wound ultimately healed, the patient, a woman, passing through the efforts of parturition afterwards without ill effects. In such cases some accidental adhesion probably has prevented the two coils of bowel from becoming bent at an angle with each other, and has thus hindered the formation of the projection of the posterior wall of the bowel which directs the fæces out of the wound.

We must now speak of the various anatomical forms of hernia, and of the treatment appropriate to each, and first of inguinal hernia.

Inguinal hernia.

Inguinal hernia is divided into two varieties, according to the position of the neck of the sac with regard to the epigastric artery. If the neck of the sac be internal to the artery it is called a direct or an internal hernia; if external, an oblique or external hernia. The latter is much the more common. The oblique variety passes out through the internal or deep abdominal ring, traverses the spermatic canal, appears below the skin through the external or superficial ring, and then drops into the scrotum. Its coverings, therefore, will be the skin, subcutaneous tissue and superficial fascia, the intercolumnar fascia, the cremaster muscle, the infundibuliform fascia, the subperitoneal cellular tissue, and the peritoneal sac.

Different forms of oblique inguinal hernia.

There are numerous forms of oblique inguinal hernia. The first is the *congenital*, in which the internal abdominal ring and the infundibuliform process of the peritoneum have never been obliterated, but the general peritoneal cavity communicates freely with the cavity of the tunica vaginalis. When this communication is of very small size no symptoms need be caused by it. It is recorded that in the post-mortem examination of Sir A. Cooper's body a minute canal was discovered leading from the internal ring to the tunica vaginalis on both sides; yet he never suffered, so far as is known, from either hydrocele or hernia. When such a communication is too small to allow the passage of the bowel or omentum it may give rise to hydrocele. Larger communications will give rise to hernia. An example is figured below (Fig. 308), in which this communication existed on both sides, and will serve to illustrate the state of parts which predisposes to congenital hernia. Such a state of parts may, however, long continue before the hernia actually makes its appearance. I have known the hernia to show itself for the first time after the age of forty, and even later periods have been recorded. By congenital hernia, therefore, is meant in surgical language not precisely a hernia originating at or before birth, but a hernia which takes place through a congenital opening. The peculiarity of congenital inguinal hernia is that the gut and testicle are in contact. When the hernia is fully formed and large the testicle is buried in the bowel, instead of being below or behind the tumour, as in ordinary inguinal hernia; but it is impossible without operation to do more than surmise the precise nature of the hernia apart from a trustworthy history. At the operation the presence of the testicle in the sac is conclusive. Congenital hernia may be known in the infant from congenital hydrocele by its want of transparency, the hydrocele being always quite transparent, and also by the feeling of gurgling in the bowel, which is rarely absent.

There are other congenital conditions which may involve the existence of

Hernia with retained testis.

inguinal hernia. Of these the most frequent is the retention of the testis in the inguinal canal. This keeps the internal ring patulous, and a hernia may easily come down which usually adheres to the testicle, but which may pass beyond it, even into the scrotum. The annexed engraving (Fig. 309) illustrates this. It shows the testicle, which is adherent to the internal inguinal ring, along with the spermatic cord, and has evidently been occasionally in the canal and at other times in the abdomen. Connected to the testicle is a hernial sac, which can travel independently of the testicle outside the inguinal ring.

In all cases of hernia it is most necessary to examine the scrotum carefully, and if it is found that the testicle has not descended on that side, then a very careful examination of the inguinal canal should be instituted, in order to see whether the testicle is detained there, and if any bowel can be felt to adhere to it, or to move independently of it. The mere retention of the testis in the canal, together with some accidental lesion, will produce



FIG. 308. Non-closure of the pouch of the tunica vaginalis, from a case in which this state of things existed on both sides. On this, the right side, there was no hernia, the ring not being sufficiently distended. But on the opposite side a hernia existed, which was strangulated and was operated on with a fatal result. The patient was five months old.—St. George's Hospital Museum, Ser. ix. No. 82.



FIG. 309. Retained testicle and sac of congenital hernia, seen from the abdomen. The testis is the globular body with a narrow neck seen on the left side of the drawing, the more cylindrical tumour, to the right and behind it, is the hernial sac.

The scrotal cord is attached to the testicle and descends beyond it through the inguinal canal, and the gubernaculum is plainly shown in the preparation attached to the testis. The retained testis is healthy and natural in character, as determined by the microscope; the spermatic cord and the testicle are adherent to the abdominal aspect of the internal inguinal ring.—St. George's Hospital Museum, Ser. ix. No. 91.

pain and vomiting; and if constipation be also accidentally present, I have more than once seen it mistaken for strangulated hernia. When the nature of the case is plain, if symptoms of strangulation be present, the operation should be at once performed; and it is better, I think, to remove the misplaced testicle. Such testicles are constant sources of trouble, and it seems very dubious whether they are of any real use.

If the hernia be not strangulated the question of wearing a truss occurs. Whenever a truss can be tolerated it should be worn, irrespective of the probability of atrophy of the testis from its pressure. For the disuse of the truss certainly entails risk of increase of the hernia and of strangulation; while, if the testis is incapable of secreting (as most of these retained testes seem to be), its atrophy is a matter of no consequence. Generally, however, the organ is too sensitive to bear the pressure, and then a suspensory bandage or a concave pad must be fitted. If the testicle is liable to frequent

attacks of inflammation it may be worth the patient's while to submit to its removal, in which case the hernial sac may either be left unopened, or may be removed and its neck stiched up as described on p. 643.



FIG. 310. Diagram of congenital inguinal hernia. The process of peritoneum which passes down with the cord (funicular process) remains freely open; the general cavity of the peritoneum is, therefore, identical with that of the tunica vaginalis testis forming the hernial sac, the bowel contained in which is in direct contact with the testicle.



FIG. 311. Diagram of the (assumed) condition of the parts in an infantile hernia. The tunica vaginalis (1) is closed above, at or near the external inguinal ring, but its funicular portion is open. The bowel in the hernial sac lies behind this funicular portion, and is represented in the diagram as having made its way between the funicular process and the cord. The relation of the sac to the cord seems, however, to be variable. The bowel is covered in cutting down from the skin by three layers of peritoneum, viz. 1 and 2, the opposite surfaces of the funicular process, and 3 the anterior layer of the peritoneal hernial sac.



FIG. 312. Another variety of infantile hernia (the encysted form). The bowel instead of passing behind the closed funicular process has distended the membrane which closes its upper end, and has pushed itself into the funicular process, the upper or back wall of which envelopes it. In this case, therefore, the hernial sac is furnished by the funicular process itself, and only two layers of peritoneum cover the intestine.

Various forms of oblique inguinal hernia.

The next form of oblique hernia is that described by Mr. Hey under the name of hernia infantilis, and which is also called encysted hernia. In this form the communication between the peritoneal cavity and the infundibuliform process leading into the tunica vaginalis is obstructed at or about the



FIG. 313. Diagram of the common scrotal hernia. The tunica vaginalis is seen behind and below, and is represented as distended with a certain amount of hydrocelic fluid, but quite distinct from the hernial sac.



FIG. 314. Diagram of partial obliteration of the funicular process to illustrate the formation of the hernia 'en bissac' and of cysts in the cord (encysted hydrocele of the cord). The cavity of the tunica vaginalis testis is closed at *c*; the funicular process is also separated from the peritoneal cavity at *a*, the situation of the abdominal ring. There is also another septum at *b*. When one or more of these septa are absent or imperfect various conditions occur, as explained in the text.

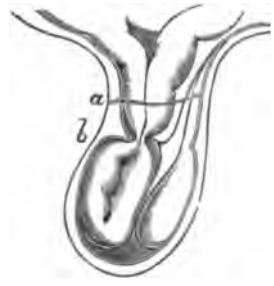


FIG. 315. Diagram of the formation of the 'hernia into the funicular process of the peritoneum' of Birkett and of the 'hernie en bissac' of French authors. Referring to the diagram Fig. 314, the septum or obliteration at *c* is supposed to be absent, so that the tunica vaginalis is open as high as the septum, *b*, which is imperfect, or has given way from some accidental cause. In the diagram the septum at the external abdominal ring, *a*, is drawn as being widely open, but strangulation may occur either in this septum or somewhat lower down at *b*, or at both.

external (or superficial) ring, but the process itself is not obliterated, so that the cavity of the tunica vaginalis extends up to the external ring. Then a hernia comes down and generally slips behind this upper prolongation of the

tunica vaginalis (Fig. 311) ; but the herniated bowel may bury itself in the upper end of the infundibuliform process and thus be encysted by it (Fig. 312). This may occur in consequence of adhesions having obstructed the neck of the infundibuliform process and formed a membrane. This membrane being distended by the protruding bowel, forms a hernial sac for it.

It seems certain also that there may be two other forms of congenital inguinal hernia, viz. one where the funicular process is obliterated at its lower part, so that it is not in communication with the tunica vaginalis, but the upper end and body of this process is not obliterated, so that the peritoneal cavity extends down to the testicle. This remains usually without any hernia till the commencement of adult life, when in some violent effort a hernia suddenly comes down and is often acutely strangulated. Or the state of parts may have been that which has just been described as the initial stage in the formation of infantile or encysted hernia, i.e. the upper end of the funicular process may have been obstructed, and this obstructing medium may have given way, causing a hernia which now is really one of the congenital form and which also will probably be acutely strangulated. It is in this way that Mr. Birkett explains the indubitable fact of the frequent occurrence of acutely strangulated inguinal herniæ in some of which the testicle is found in the sac, and not in others. Hey, in describing his infantile hernia, has pointed out that the membrane which shuts off the cavity of the peritoneum from the expanded or infantile tunica vaginalis (Fig. 311) may give way again and admit a hernia into the cavity containing the testicle, the hernia being therefore of the congenital form, though it does not occur congenitally nor from congenital patency of the funicular process ; and he cites a passage in which William Hunter had pointed out the possibility of this event, though he had never seen a case (Hey's 'Pract. Obs. in Surgery,' p. 229).

The other forms of inguinal hernia are acquired, i.e. they form slowly, the inguinal canal being in the condition natural to the adult (Fig. 313). The peritoneum, containing omentum, gut, or both, is slowly projected at the internal ring down the scrotal canal. If the hernial tumour has not reached the external ring the disease is termed *bubonocele*. It presents a small rounded swelling, traceable to the internal ring, where it becomes lost without any neck, very little movable, with an impulse on coughing, and reducible under ordinary circumstances. Its diagnosis is sometimes difficult, the affections with which it is most liable to be confounded being enlarged inguinal glands and encysted hydrocele of the cord. Neither mistake is possible, however, when the bubonocele is completely reducible, and presents a distinct impulse. If the symptoms of strangulation should be present they are always a sufficient reason for treating the disease as a hernia and cutting down on the tumour, though there is no doubt that a cyst lying high up in the cord may so far simulate a bubonocele as to deceive the best surgeons, the symptoms having depended on the strangulation of some small deep-seated hernia (such as obturator hernia) or on strangulation of the bowel inside the peritoneal cavity (see Fig. 288, p. 624, and 319, p. 662). Usually, however a cyst in the cord or an enlarged gland can be pulled down sufficiently to convince the surgeon that it is separate from the internal ring. Besides which the cyst, if it is at all large, will show its characteristic transparency on very careful examination, and the position of the inguinal glands is not exactly that of inguinal hernia. However, when any doubt exists and the symptoms of strangulation are present, it is far more prudent to ascertain the nature of the case by an exploratory operation.

Bubonocele.

The common external or oblique hernia forms a large tumour which lies generally above or in front of the testicle with a long neck reaching up to the position of the internal ring, the cord being generally behind it, though instances are not wanting in which the cord is spread over the front of the tumour, or in which the elements of the cord are separated and lie on either side of the neck of the sac. The abdominal muscles are tightly spread over the upper part of the neck of the sac in the canal; and I have met with several cases in which strangulation has been produced by tight bands running across it, probably portions of the tendon of the external oblique, on the division of which the hernia was at once reduced. The neck of the sac is often most tightly constricted at the internal ring (see Fig. 303, p. 646), and this lies at a very great depth when there is a large hernial tumour, besides which there are often one or more minor constrictions in the course of the canal which must be divided before the operator arrives at the ring. So that the operation is often both severe and troublesome.[1] The epigastric artery lies close to the inner margin of the ring and at its lower border. The incision into the neck of the sac should, therefore, be directed upwards. When the hernia is of gradual formation and old standing the neck becomes much less oblique and relatively shorter, so that its mouth is more easily reached. Such herniæ, also, are far more likely to be strangulated external to the sac, and to be susceptible of relief by the extra-peritoneal operation.

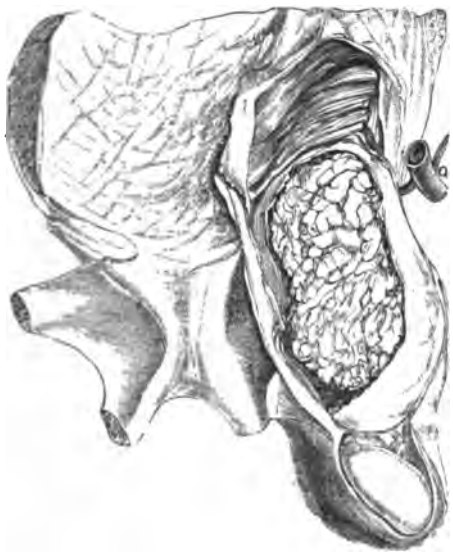


FIG. 316. An oblique inguinal hernia seen from the outside. *a* shows the epigastric artery coming off from the external iliac and winding round the neck of the sac.—St. George's Hospital Museum, Ser. ix. No. 72.

The operation for bubonocele is of the same nature as that for scrotal hernia. In both an incision is to be made along the long axis of the tumour, which is most conveniently done by pinching up a fold of skin transversely and transfixing it, the incision being made of sufficient length to give easy access to the neck of the sac at the internal ring. The various layers of fascia having been divided successively (on a director, if they are tense), the surgeon may examine for any bands which he can feel constricting the tumour external to the sac, and divide them by passing a probe-pointed bistoury beneath them. If the hernia is still irreducible the sac must be opened and the neck of the tumour traced up into the peritoneal cavity, in doing which the seat of strangulation will be met with. In a voluminous tumour, with a tight, deep-seated stricture, much care is needed (especially with an inexperienced assistant) to keep the bowel out of harm's way while incising the

[1] Such constrictions sometimes form real double sacs, as would be the case in Fig. 314, if the septa *a* and *c* were imperfect, and the hernia covered by the septum *b*, after passing through them, had become enlarged, or the septa *a* and *c* had contracted so that the gut were strangulated at both points.

stricture. It is of no use to commence the reduction of the bowel until the stricture has been so thoroughly divided that the finger passes easily into the cavity of the peritoneum, and it is of course necessary to have the bowel and omentum freed from any entanglement with each other, and to ascertain the absence of adhesions.

Direct inguinal hernia.

Direct inguinal hernia is far less common than oblique. It does not occur congenitally, in the male sex at least. The bowel protrudes in the space denominated the triangle of Hesselbach, which is bounded externally by the epigastric artery and internally by the sheath of the rectus muscle, Poupart's ligament forming its base. Two varieties of this hernia are described in the anatomical theatre as occurring in cases where the obliterated hypogastric artery divides Hesselbach's triangle into two parts. In the ordinary state of parts it seems more common for the course of this obliterated vessel to correspond pretty nearly with that of the epigastric. Its projection inwards throws the peritoneum into two fossæ, the bottom of the internal fossa being at the external or superficial ring, while the bottom of the external fossa will lie at the internal or deep ring when the course of the hypogastric and epigastric vessels correspond, but will be internal to the deep ring when the obliterated artery runs across the triangle; and in the latter case the hernia will push before it the walls of the spermatic canal, and pass down a portion of that canal before reaching the superficial ring. This causes a slight difference in the coverings of these two forms of hernia. The common form of direct hernia is covered by the skin, subcutaneous tissue or superficial fascia, intercolumnar fascia, conjoined tendon, transversalis fascia, and subperitoneal tissue, while the less usual form has the cremaster muscle or fascia in place of the conjoined tendon. This is not a matter of any consequence; in fact, it could only be demonstrated by very careful dissection; what is of more surgical importance is to remember that the neck of the sac may be very close to the epigastric artery. In the ordinary form the epigastric artery is at such a distance as to be quite out of the way in an operation. In all cases, therefore, it is better to incise the neck of the sac directly upwards. Direct inguinal hernia passes at once into the scrotum, and its diagnosis is not usually a matter of any difficulty. The neck of the sac is more superficial than in oblique hernia, and the operation is therefore simpler, but is the same in principle and in most of its details.

Inguinal hernia in the female.

Inguinal hernia occurs also in females, and a certain amount of protrusion at the external ring and into the top of the labium is very common in female infants—congenital hernia—which as a rule gradually disappears without any treatment, but if unusually large requires the constant application of a truss, just as congenital hernia does in the male. A congenital hydrocele (hydrocele of the round ligament) also occurs in females, and may be mistaken for hernia, though the disease is a rare one. In infancy I am not aware that the difficulty occurs, but, in the adult, cases have been recorded in which an operation has been necessary in order to settle the diagnosis. The tense nature of the tumour, the want of impulse on coughing, and in some cases its translucency, are the chief diagnostic marks; but in this, as in all embarrassments of diagnosis, when the symptoms are sufficiently urgent to justify it, an exploratory operation should be early performed. The inguinal hernia of later life in females is of the acquired form and usually direct. No special directions are necessary for the operation in either form.

Femoral hernia occurs more commonly in the female than in the male sex,

Femoral hernia.

although it is by no means rare in men. The hernia is never of the congenital form, and therefore occurs very rarely in childhood. There seems no doubt that pregnancy and parturition predispose to it. The neck of the sac is at the crural ring, which is tightly constricted at its inner and upper part by the deep crural arch, the upper cornu of the falciform opening, and Gimbernat's ligament. The pressure of these dense unyielding structures often causes very acute strangulation, in which circumstances the symptoms are urgent and taxis unsuccessful. The neck of the sac can be traced below Poupart's ligament, though its fundus, or the body of the tumour, in many cases rises up into the abdomen, lying open that ligament. The coverings of a femoral hernia are the skin, the subcutaneous tissue and superficial fascia, the cribriform fascia, the sheath of the vessels, the crural septum, and the subperitoneal tissue. The crural ring, or the mouth of the sac, has on its outer side the femoral vein, and the epigastric vessels lie a little above it; but it has usually no important vessels at its inner and upper angle, where the incision is made to relieve strangulation. The anastomosing artery between the epigastric and obturator passes around the ring, and its size varies considerably, so that sometimes free bleeding occurs in this incision, and in fact I have known such hæmorrhage prove fatal in a case where, the vessels being uninjected, no conspicuous artery could be detected at the post-mortem examination. But in cases of anomalous origin of the obturator artery the trunk of this vessel may entirely encircle the ring, so as to be in danger of being divided at the operation. This is not ordinarily the case even when the obturator comes off from the epigastric, for the anomalous artery usually takes its course towards the obturator foramen on the outer side of the sac, as shown in Fig. 317, and is quite out of harm's way. But when, as in Fig. 318, the

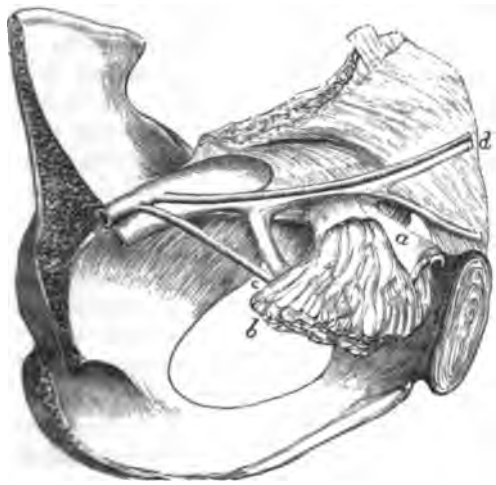


Fig. 317. Irregular distribution of the obturator vessels in a case of femoral hernia. The obturator artery arises from the external iliac close to the origin of the epigastric; the vein opens into the epigastric vein. As, however, they lie on the outside of the hernial sac, there could be no danger in an operation. *a*, the hernial sac, on the inner side of which the incision would be made in case of strangulation; *b*, its contents; *c*, the obturator vessels; *d*, the epigastric vessels.—St. George's Hospital Museum, Ser. ix. No. 84a.

Irregular distribution of arteries round the neck of the sac.



Fig. 318. A specimen of femoral hernia in which the obturator vessels are given off from the epigastric and encircle the neck of the sac. *a* shows the artery curving over the inner side of the sac, and just above the letter a dark space is seen, which is an extension from the wound of the operation. *c* shows the edge of Gimbernat's ligament. The vein (cut short) is marked by the letter *b*.—St. George's Hospital Museum, Ser. ix. No. 84.

obturator vessels pass around the neck of the sac, they are liable to be wounded in dividing the stricture; although they may accidentally escape. In the instance from which that figure was drawn it seemed probable that the vein was wounded at the time of the operation, but the artery escaped, though it gave way afterwards. There was considerable venous hæmorrhage at the time of the operation; but this was suppressed by pressure. A good deal of omentum which was in the sac was left in the wound. Sloughing attacked the wound, and then arterial hæmorrhage took place, the source of which could not be discovered. It recurred two or three times, and proved fatal. The vein and artery were both found open, the opening in the artery being a minute puncture, into which a bristle could just be passed. As it is impossible to ascertain the existence of this anomaly, the only security against injuring the vessels is to make the incision as small as is consistent with the easy reduction of the hernia.[1] If the artery has been wounded the surgeon may possibly succeed in securing it, either by seizing its mouth and tying it, as some operators have claimed to have done, or by thrusting a curved needle under the tissues in which the bleeding vessel lies and passing a ligature around them, needle and all, as in one of the forms of acupressure, or possibly by the method of 'uncipression' recommended by Vanzetti (see p. 98). The reader will find in vol. xi. of the Clinical Society's 'Transactions' an interesting paper by Mr. Barker, containing the history of a case of his own and a *résumé* of the recorded cases of this accident, with a discussion on the treatment. Cases of spontaneous recovery after a supposed wound of the obturator artery have no doubt occurred. Still I think few surgeons would doubt that if an artery of considerable size has been wounded in this situation, the operator ought to do all in his power to secure it in some way.

Diagnosis of femoral hernia.

Femoral hernia is not always easy of diagnosis. Enlarged glands sometimes lie in the crural canal and exactly simulate a small hernial tumour, the impulse in which is absent or obscure. In fact, so close is the resemblance that exploratory operations are frequently performed. And a small hernial sac may be found lying behind an enlarged gland. The diagnosis is best made by the greater mobility of the gland, its being isolable from the underlying parts, its having no impulse when separated from the abdominal muscles, and its owning some cause, such as a sore in the lower limb, buttock, anus, or parts of generation.

Varix of the saphena vein has been mistaken for hernia, but is distinguishable by the fact that after reduction of the tumour—which may be accomplished easily in the recumbent posture—pressure on the ring, which would keep the hernia back, will cause the varix to reappear.

Psoas abscess has been mistaken for hernia, and has often a very perceptible impulse. But the fulness in the iliac fossa which always can be detected by careful examination in psoas abscess would alone be sufficient for diagnosis; besides, a strict examination will show that the region of the crural ring is natural, the swelling being at a point below this on the inside of the thigh, and being also perceptible on its outer side. Some very rare cases of hernia, however, have been recorded in which a hernia has descended on the outside of the femoral artery.

A cyst has sometimes been found to lie in the crural ring, which must be distinguished from hernia by the same signs as an enlarged gland.

The tumour in femoral hernia is usually small, though cases are met with

[1] It is desirable on every ground to make the incision into the neck of the sac as small as possible, for if the neck of the sac be too much enlarged it is very difficult to apply a truss satisfactorily.

in which it is of large size; it generally turns upwards after reaching the saphenous opening and requires to be drawn somewhat downwards before the true position of its neck is seen. Immediate attention should be given to it and it should be kept rigidly reduced, since its strangulation is very often irremediable except by operation.

The operation is exactly the same in principle as that for inguinal hernia, only that here the crural ring and the edge of Gimbernat's ligament are the points towards which the surgeon aims. An incision is made over the long axis of the tumour, somewhat internal to its middle, and the parts are divided until the sac is exposed. Then a director may be passed under Gimbernat's ligament (or any other constricting tissue that can be felt), as recommended by Mr. Gay,[1] and the extraperitoneal operation attempted. If this does not succeed the sac is to be opened.

Umbilical hernia.

The only other form of hernia which is of very common occurrence is the umbilical. This occurs constantly as a congenital affection, the bowel protruding through the unclosed navel. And there can be no doubt, from the rarity of the affection in the adult as compared with its extreme frequency in the infant, that this congenital umbilical hernia tends to spontaneous cure. Nevertheless, it should not be neglected, especially when large. The bowel should be kept reduced by means of a well-fitting pad which covers the whole ring, and which is kept accurately applied to the belly by being let into a laced belt with indiarubber sides. If this apparatus is too costly some extempore substitute can be easily devised. Careful attention for a few months is almost sure to be followed by the disappearance of the swelling.

The acquired form of umbilical hernia is generally caused by the distension of the abdominal parietes, as a consequence of obesity, repeated pregnancy, or both. The subjects of strangulation in this form of hernia are often fat elderly women, who have had the disease for a long time and neglected it. The ring is often of very large size, the sac almost always contains omentum, and frequently large intestine as well as small. The hernia is covered only by the skin and expanded linea alba, and its orifice is often not the navel itself, but some weakened part of the neighbouring linea alba. Often in this hernia the symptoms which are described as strangulation are rather those of obstruction; and constipation with vomiting may continue for several days, and yet be susceptible of ultimate relief from rest, enemata, and the administration of calomel and opium. The hernia is very probably irreducible, the sac being coated internally with omentum (for in this hernia the 'omental sac' is very common), and the symptoms are rather due to the entanglement of distended bowel in the folds of this omentum than to strangulation by any definite band. The obstruction may subside on the subsidence of distension; and the results of operations on these irreducible herniæ containing large quantities of omentum are so unfavourable that it is prudent to avoid them if possible. The amount of pain and fever (in other words, the acuteness of the symptoms) is the test of the necessity for an operation. If the tumour is very tense, the pulse quick and irritable, the tongue dry, and the patient complaining greatly of pain in the tumour and the belly, the operation should not be delayed, especially if the vomit be inclining to the fæcal character.

The tumour is to be freely laid open in the vertical direction, the contained bowel and omentum unravelled, and the finger passed beneath the ring to feel for the point of stricture. This being divided, the bowel should be first reduced, and the omentum then dealt with as seems advisable. All the

[1] See Mr. Gay's work on 'Femoral Hernia.'

precautions which are taken in other abdominal operations in order to avoid putrefaction should be adopted also in that for umbilical hernia; and it seems advisable to sew up the ring with catgut sutures after having returned the hernia.[1]

I have seen a case in which the symptoms which were referred to an umbilical hernia turned out after death to have been due to strangulation of the bowel internal to the peritoneum, and fairly within reach of the operator. Remembering this case, and that under Mr. Bryant's care cited on p. 625, it would be advisable, if no strangulation is found in the hernial sac, to pass the finger into the peritoneal cavity in order to ascertain whether there is any internal constriction.

Obturaror hernia.

Of the rarer forms of hernia the obturator, though not the most frequent, is that which presents most of surgical interest, since it has in late years been made the subject of successful diagnosis and treatment.[2]

Fig. 319, from a case which occurred at St. George's Hospital before the successful treatment of this disease was known, will well illustrate its main features. The small sac (*a*) of the obturator hernia is seen lying at the upper and outer part of the thyroid foramen, almost vertically below the femoral ring, and there is a small empty hernial sac also in the external inguinal ring (*d*). Mr. Birkett has collected twenty-five cases of strangulated obturator hernia,[3] from which it appears that this variety of hernia when strangulated may be distinguished from inguinal hernia by finding the inguinal rings and canals empty, and from femoral by the empty condition of the femoral ring, by the fulness of the 'femoral fossa' (by which term is intended the flat surface of the thigh, just below Poupart's ligament, the floor of which is formed by the pectineus muscle), by the fact that the femoral vessels lie in front of the tumour instead of outside it, by the position of the neck of the sac if perceptible below the ramus of the pubes, and by pain, which is often present in the course of the obturator nerve. But the diagnosis is often very difficult, and in many of the recorded cases (as in that here figured) other forms of hernia



FIG. 319. Obturator hernia in a female, æt. sixty-seven, who died in St. George's Hospital, in the year 1846, from the strangulation of this hernia. She had also a small inguinal hernia, but the sac appeared to be empty. An exploratory operation was performed, and proved that this was the case. In the preparation the small sac is seen opened outside the external abdominal ring, and with a bristle placed in it (*d*). Below the femoral vessels and horizontal ramus of the pubes the sac of the obturator hernia (*a*) is seen unopened, projecting from the outer margin of the thyroid foramen, and having the nerve and vessels (*b*) on its outer side. It contained a small knuckle of intestine, comprising only part of the calibre of the bowel, tightly strangulated.[4] *c* shows the acetabulum. —St. George's Hospital Museum, Ser. ix. No. 80.

[1] See Reverdin in 'Revue Médicale de la Suisse Romande,' Jan. 15, 1882. Rushton Parker, op. cit.

[2] This very satisfactory advance in operative surgery was due, not to a hospital surgeon, but to the late Mr. Obré of Paddington.—'Med.-Chir. Trans.' vol. xxxiv.

[3] 'Syst. of Surg.' 3rd ed. vol. ii. p. 826.

[4] The hernia usually contains a portion of small intestine. A case is reported in the 'Annali Univ.' Feb. 1877, by Dr. Zoja, in which the bladder partly protruded through the obturator foramen, a condition which seems to have been known or suspected by some of the old anatomists.

have been present and have complicated the case. In some it is said that no tumour has been found, and such cases could not be distinguished from instances of internal strangulation. But whenever the symptoms of strangulation are present with no tumour in the situation of the umbilical, inguinal, or femoral herniæ (or if such herniæ though present are completely reducible), the femoral fossæ on the two sides should be carefully examined both by palpation and sight, and if any fulness on one side be observed as compared with the other, it will be justifiable to perform an exploratory operation, for which there is still more encouragement if the characteristic pain in the course of the nerve is present. The incision should be made as for femoral hernia, but should be extended further downwards, so as to have a very free opening, lying to the inside of and well away from the femoral vessels. The pectineus muscle being exposed, is to be freely divided in the course of the skin-wound and the sac searched for and opened. It may be even necessary to separate or to divide some of the fibres of the obturator externus muscle before the sac is reached, but the surgeon should not desist from his search until the obturator foramen is clearly exposed. The position of the vessels and nerve with regard to the sac being variable, this search must be conducted carefully. If the hernia be recognised while reducible (and Mr. Kingdon has made the diagnosis no less than five times) the surgeon must explain the nature of the case to the truss-maker, and must see that the pressure acts in the right spot, and is directed backwards and somewhat upwards below the ramus of the pubes.

Ventral hernia.

Hernia occurs also at any part of the belly which has been weakened by a cut, or by accidental rupture of a part of the muscular fibres, or an abscess, or possibly by over-distension. To such herniæ the name of 'ventral'[1] is given. The protrusions which follow on ovariotomy or ligature of the iliac arteries are familiar examples. Such hernial sacs have no neck, and are very little liable to strangulation. When the patient stands up or coughs they form large bulging tumours, in which the bowels can be plainly felt. Reduction is perfectly easy, and the wearing of an appropriate bandage, so as to keep the hernia completely reduced, is all that is necessary, as far as I have seen.

Phrenic hernia.

Phrenic or diaphragmatic hernia occurs as a congenital defect, a portion of the diaphragm, usually the left leaflet, being deficient, whereby the pleural and peritoneal cavities communicate quite freely, and the stomach, the transverse colon with its omentum, or other viscera, are allowed to pass freely into the thorax. It is surprising that this extensive malformation should produce no definite symptoms. I have more than once found it in the bodies of adult persons who died from other causes and had never been known to make any complaint connected with the hernia.

But in other cases the diaphragm has been ruptured in consequence of severe contusion, or has been lacerated by direct wound. When phrenic hernia occurs after injury it is generally a consequence of the free rupture of the muscle from contusion, which, like the congenital defect, takes place usually on the left side. The stomach and transverse colon are, therefore, the viscera which usually protrude in this form also, and the accident may possibly be diagnosed by the greater fulness and unnatural resonance of that side of the chest, the sickness, and the symptoms of obstruction which follow it. As the accident is almost inevitably fatal, either from pleurisy or from strangulation, the question of cutting freely into the abdomen and endeavouring to

[1] Some of these herniæ when lying between the cartilages of the false ribs and the navel are called 'epigastric.'

reduce the viscera from below has been mooted; but no case has as yet occurred in which the diagnosis has been made clearly enough to justify the surgeon in this hazardous attempt, and the record which we now possess of cases in which the patient has survived for a considerable length of time would still further indispose any prudent person from making such an attempt. Mr. Le Gros Clark has related and figured a most interesting case, in which the patient lived more than two years after an accident in which there seemed good reason to believe that the diaphragm had been lacerated, and in whom after death the usual conditions of phrenic hernia no doubt existed. The only ambiguity about this case is the remote possibility that the deficiency of the diaphragm might have been congenital.[1]

Vaginal hernia.

The other rarer forms of hernia occur chiefly in the vagina or female perinæum. Vaginal hernia is not, I think, on the whole so rare as is supposed. It occurs as a congenital defect or as a consequence of stretching of the vaginal walls in parturition. The diagnosis is generally very easy. In a congenital case I ventured upon an operation to close the ring, which appeared successful.[2] In the adult I have never seen any inconvenience, but it has been observed that in some cases the urinary bladder protrudes—an affection, however, which should be distinguished from hernia, under the name of *vaginal cystocele*. The intestinal hernia only requires support by an appropriate form of pessary. The vaginal cystocele may require to be operated on by removing a limited portion of the vaginal wall and sewing up the edges after having reduced the prolapsed bladder.

Perinæal, pudendal, ischiatic, and lumbar herniæ.

In perinæal hernia the recto-vaginal pouch of peritoneum is thrust out between the vagina and rectum, forming a hernial sac with small intestine in it, and I have seen the same thing occur into the rectum itself. Cases rarely occur in which the male perinæum is similarly pushed out. These herniæ merely require reduction and proper support.

Of a similar nature are the pudendal hernia, in which the neck of the sac lies between the ascending ramus of the ischium and the vagina, and the sac itself protrudes into the posterior part of the labium; the ischiatic hernia, where the gut protrudes beneath the glutæus maximus muscle and the neck of the sac lies either above or below the pyriformis; and the lumbar hernia, in which the bowel makes its way between the quadratus lumborum and external oblique muscle.

In all these forms of hernia the main point is their diagnosis, and in all such swellings around the female parts of generation this is a matter to which much care should be given; but space fails me to enumerate the exact points of distinction between such herniæ and the abscesses, cysts, or other formations which may be met with in each region, nor is it perhaps necessary. A surgeon who is well acquainted with the principles of diagnosis and pays proper attention to his patient will be in little danger of mistaking a lumbar hernia for an abscess or a vaginal hernia for a cyst.

As to treatment, I am not aware that any of these forms of hernia have required kelotomy; but if they should, the operation would present no special difficulties, except, perhaps, in sciatic hernia, in which a large incision would have to be made, and care taken to ascertain if possible the position of the gluteal or sciatic vessels in relation to the neck of the sac. Sir A. Cooper directs that in such a contingency the incision into the neck of the sac be made directly upwards.

[1] Lectures on the 'Principles of Surgical Diagnosis,' p. 258.

[2] Holmes's 'Surg. Dis. of Children,' 2nd ed. p. 560.

CHAPTER XXXIII.

DISEASES OF THE RECTUM.

Hæmorrhoids

HÆMORRHOIDS, or piles, are divided into external and internal, and the division is a useful and natural one, though there are many examples of piles in which both the mucous membrane of the bowel and the skin external to the anus form a part of the covering of the tumour, and which, therefore, are partly external and partly internal. Both kinds of piles are formed of enlarged vessels surrounded by infiltrated cellular tissue. External piles consist internally of an enlarged vein or veins, partly occupied by clot, and externally of skin and connective tissue more or less thickened and inflamed. They owe their origin to any cause which determines the blood to the part or prevents its return. Pregnancy, obstruction to the portal circulation, too luxurious habits, and sedentary employments are well-known causes of external piles, and they are very commonly increased by any accidental attack of constipation. These external piles are liable to inflammation, when they become distended, livid, and intensely painful.

External piles.

In cases of external piles there are generally also folds of loose integument about the anus in which no enlarged vessels can be detected, nor does the skin or cellular tissue appear indurated.

Treatment of external piles.

The treatment of external piles consists in the removal or palliation of their cause and the application of sedative and astringent lotions or ointments, and this is quite sufficient in the great majority of cases. When habitual constipation exists it must be relieved, and the bowels kept rather loose, by some mild laxative, for purging is by no means desirable. The confections have obtained an extensive reputation for this purpose, especially the Conf. Sennæ c̄ Sulphure and the Conf. Piperis Nigri. All improper habits, whether of diet, exercise, or anything else that can promote irritation about the pelvic organs, should be given up, and the patient should be encouraged to take gentle but regular exercise.

When the piles are inflamed, if the inflammation is mild, leeching is often serviceable; if severe, the tumour should be cut across with a lancet, and the blood squeezed out of the mouth of the vein, for an imperfect clot might keep the mouth of the vessel open and encourage bleeding. Also when old piles have become much indurated and are liable to constant attacks of irritation, it is better to snip them off, and along with them to remove any loose folds of skin. But in doing this care should be taken not to cut into the anus, so as to implicate the mucous membrane in the incision. Negligence in this respect has been followed by very troublesome contraction of the orifice of the anus.

Internal piles.

Internal hæmorrhoids are produced by causes similar to those of the external variety, but they constitute a far more formidable malady. They produce bleeding, which in the worst cases is constant, though greater during defæcation, and which so exhausts the patient as to drain him of all strength and colour and leave him waxy in complexion, exhausted, languid, and unable to make any continuous effort. The piles may also cause pain and straining in defæcation; and if the tumours are large they may protrude even

when the bowels are not acting, and sometimes drag the whole end of the gut out of the anus—prolapsus. They are generally situated close to the anus, and often are partly external as well—i.e. part of them is covered by skin—but sometimes they are seated at a little distance up the bowel, and hence the necessity of having the bowel well protruded in examinations for piles. This is accomplished either by the patient's voluntary efforts, which are quite sufficient in cases where there is any tendency to prolapsus, with, perhaps, a little assistance by gentle traction on some of the more prominent tumours, or by filling the bowel with a large quantity of warm water, so as to make it act forcibly, when the whole will be protruded, or by sitting over warm water. The structure of internal piles is less uniform than that of the external variety. Some consist chiefly of varicose veins, with more or less condensed cellular tissue; in some the mucous membrane is also hypertrophied; while in others the hypertrophy of the mucous membrane and its capillaries seems to constitute the bulk if not the whole of the tumour; in others, again, there are large arteries intermingled with the enlarged veins or capillaries and with the hypertrophied mucous membrane. The form also of these tumours varies equally. Some of them are sessile and bright red like a strawberry, while others are pendulous and livid, the arterial vessels or enlarged capillaries predominating in the former, the venous in the latter; while in piles which have long been irritated and inflamed the bulk of the tumour will be formed of condensed cellular tissue, there will be little trace of vascularity in its appearance, and its consistence will be harder.

Treatment of internal piles.

The treatment of internal piles must vary according to their extent, appearance, and form. When only recent, and of no great size, they may usually be relieved, as external piles may, by removing or palliating their causes, and by similar treatment—i.e. gentle purgatives or laxatives—unloading the liver, and astringent applications, as the Ung. Gallæ Co., to the tumours when protruded, or astringent injections in small quantity after the bowels have acted. The patient ought to be instructed always to return the piles, when protruded, by gentle pressure. The constriction of the sphincter on the protruded piles produces much pain and congestion in the tumours. Sometimes, it is true, this proves curative, the whole tumour sloughing as if the sphincter acted as a sort of natural ligature, but this is too rare and too uncertain to be counted on. Far more commonly the congestion increases the bleeding and causes painful inflammation.

In cases where the bleeding is considerable or the other symptoms are urgent some steps must be taken to remove the piles. The least painful and dangerous is the application of strong nitric acid to the whole of the surface, under which it will shrivel up—possibly the superficial part of the mucous membrane will exfoliate—and thus a cure be obtained. No doubt for those piles which are of the sessile and capillary variety such treatment is often very efficacious, at least for the time. It not unfrequently happens that the symptoms recur, but in that case the treatment can be repeated. It causes usually but little pain, and is attended with no danger; at least I have never seen or heard of any harm from it. But it is not likely to succeed in tumours of large size, and in those which are pendulous or hardened from inflammation it is useless. As these three classes form the majority of piles which require operation, it follows that the treatment by nitric acid is not very frequently serviceable.

There are two chief plans of operating for piles, viz. with the ligature

and with the clamp and cautery. In the former each pile is drawn out in succession with the forceps, any skin which is covering it is turned off the hæmorrhoidal tumour with a knife or scissors, its base transfixed with a stout double silk ligature if large, or encircled in a ligature if smaller, and the ligature tied as tightly as possible and cut short. Some surgeons puncture the pile, or cut away its superficial part, but this is unnecessary. When all the piles have thus been tied the mass is returned into the bowel. In operating with the cautery each pile is, as before, successively drawn out and then a clamp is applied to its base. The clamp should have its lower surface coated with ivory, so that the heat applied to its upper part may not burn the skin. If the pile is only small its whole tissue may be seared down nearly to the level of the clamp by the cautery, or this may be done without any clamp; but it is generally necessary to cut off the pile a short distance above the clamp, and then sear the base of it till a thick eschar is formed. Mr. Bryant says that for this purpose the galvanic is better than the actual cautery, as forming a thicker eschar. It has the advantage that the supply of heat is continuous, and the disadvantage that the surface of the cautery is not so large. A heat a little below white heat is safest, because it chars the tissues more slowly—if burnt too rapidly the eschar may stick to the cautery and be pulled away, causing bleeding. When the

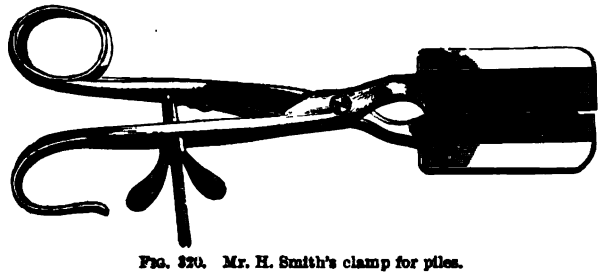


Fig. 320. Mr. H. Smith's clamp for piles.

surgeon thinks the parts sufficiently seared he cautiously relaxes the screw of the clamp, and if any point still bleeds repeats the cauterisation. When all is safe and every pile has been treated in this manner the whole is returned into the bowel with all possible gentleness.

An anæsthetic may be given in any operation for piles, but it makes the proceeding a little more difficult, as the piles are rather liable to slip up while the patient is becoming unconscious. However, filling the bowel with water or gentle traction will bring them down, and few patients have the resolution to submit to the actual cautery without it, though in reality the operation does not seem very painful.

The operation by the cautery is the more recent of these two plans, and is the one now in greater use,[1] and it has some incontestable advantages over the ligature—the recovery is more rapid, there is less need of confinement to bed, and it is less painful than the ligature. Against these advantages is to be set the risk of secondary hæmorrhage—which, however, is not very great—and the somewhat terrifying nature of the proceeding, if from any cause anæsthetics are not used. As to danger, though very confident opinions were expressed of the greater safety of the cautery, further experience has shown their incorrectness. Pyæmia follows operations for piles, in consequence of

[1] Perhaps this is true rather of hospital than private practice. Mr. Curling, in the last edition of his work on 'Diseases of the Rectum,' 1876, p. 64, says, 'I continue to give the preference to the ligature, as more convenient to the surgeon and less alarming to the patient.'

inflammation of the divided veins. This is very rare in any form of operation, but seems to occur quite as often after the cautery as the ligature. Tetanus has been known to occur after ligature, but it is a very rare event indeed.

Bloodless operations for piles.

I have lately seen cases treated by my colleague, Mr. Pollock, and have treated a few myself, with success by simply crushing the base of the pile with a clamp somewhat similar to that figured on p. 667; by which the whole base is equally and severely contused, after which the pile will often wither away. Or the surface of the pile may be seared with the actual cautery, at the same time as its base is clamped. The advantage of such operations is that as no wounded surface is exposed, there is no risk of phlebitis or pyæmia, for which reason they are chiefly to be recommended in patients of broken constitution or those labouring under known visceral disease, when it is judged expedient to operate on such patients; but as they are at the best uncertain of success, is seems better to resort to more radical measures at once when there is not the same reason for regarding the issue of the case with apprehension. Mr. Reeves has described in the 'Lancet,' vol. i. 1877, p. 229, a method of treating internal piles by which he believes the cure is more rapid, more permanent, and more safe than by any other operation. The piles being well protruded are punctured with a sharp point attached to Paquelin's Gas-cautery raised to a dull red heat. The cautery is then rotated and gently withdrawn so as not to cause bleeding. According to the size of the pile one puncture, two, or three may be required. After all the piles have been thus treated, they are returned and a half-grain morphia suppository introduced. The bowels are kept confined for about four days, and then an injection is given. The cure, according to Mr. Reeves, is usually complete in a week, and ample experience has convinced him that relapse seldom or never occurs.

The old plan of excising the hæmorrhoidal tumours has recently been re-introduced by Mr. Whitehead of Manchester.[1] He distends the sphincter forcibly, so as to suspend its action, in order to obviate any danger from secondary hæmorrhage, dissects the piles from the mucous membrane around until they are attached only by their stalks (in doing which it is very desirable to leave longitudinal strips of mucous membrane continuous with the skin), and then cuts off the pile, commanding the hæmorrhage by torsion. Mr. Whitehead's cases appear to have been successful; but the proceeding seems more dangerous than the ligature, and I do not see in what respect it is superior to it.

Prolapsus ani.

By prolapsus ani is meant the inversion of the lower part of the bowel, and its protrusion in the form of a ring of red tumid membrane. In slighter cases this ring consists of the mucous membrane only, but in the more formidable examples the whole bowel protrudes, and sometimes for several inches. Its causes are constitutional and local. Thus, in cachectic children with relaxed fibre any intestinal irritation, such as worms, will produce prolapsus, and in the healthiest persons, whether children or adults, prolapsus may be caused by any cause of straining, as stone, stricture, or enlarged prostate. Mr. H. Smith also says, with indisputable truth, that 'the pernicious plan of frequently using copious enemata is very constantly productive of the disorder.' The first thing, then, is to ascertain the cause, and if this can be removed the prolapsus, if moderate, will soon disappear with a little attention. When the general health is at fault the appropriate treatment must be employed. In childhood ferruginous tonics are commonly needed, and if the complaint

[1] 'Brit. Med. Journ.' Feb. 4, 1882.

depends on the irritation of worms this must be remedied. In this way most cases of prolapsus will be cured if the protruded bowel be always at once carefully reduced (which is generally easily done by pressing it gently up with the flat of the hand) and supported by a T-bandage. If very large the protruded mucous membrane is to be pencilled over with nitrate of silver in stick or smeared with nitric acid. For the cases which resist such measures (which will be very few, and chiefly inveterate cases in the adult) an operation similar to that for piles must be performed, portions of the inverted gut being tied at opposite parts of the circumference of the bowel, so that the resulting cicatrisation may keep the gut in; or, if the anus be very much stretched, lunated pieces of the skin and bowel may be removed with the scissors, and the edges of each wound stitched together; or similar portions of the skin and bowel may be clamped, cut off, and seared, just as in the operation for piles. And in fact the combination of prolapsus with piles is very common, as stated above.

Fistula in ano.

A fistula in ano is a channel or sinus leading by the side of the rectum, and having usually two openings (complete fistula), the upper one in the bowel, and the lower on the skin. The upper opening is generally very near the anus, and the lower is also generally not far from the margin of the orifice, so that the fistula is usually of no great length. But many exceptions occur in both respects. The sinus may open a long way up the gut, and the external orifice may be a very long way from the anus; and again there are fistulæ which pursue a curved course, coasting round the bowel as they pass upwards, so that the opening in the gut is on the opposite side from that on the skin ('horse-shoe fistulæ'), or a single opening in the bowel may communicate with two or more orifices on the skin ('Y-shaped fistulæ'). Inattention to these peculiarities may cause a surgeon to overlook the internal orifice in cases of complete fistula. But there is no doubt that incomplete fistulæ also exist, and that of two kinds—blind external fistula (Fig. 321), in which there is a sinus leading up along the bowel, but no internal opening; and blind internal fistula, where there is an opening in the bowel, leading down into the cellular tissue, but no orifice in the skin.



FIG. 321. Fistulæ in ano, without any internal opening. There are two fistulous openings, into which bougies have been inserted, and which run for some distance in the cellular tissue, terminating beneath the wall of the bowel. At *a* is an elliptical depression which has every appearance of being the original orifice of one (perhaps of both) of the fistulæ, but is now soundly healed.—Museum of St. George's Hospital, Ser. ix. No. 45.

Fistula originates in two ways, viz. either as an ulcerated opening in the wall of the bowel, the matter from which makes its way down along the gut to open externally, or as an abscess in the cellular tissue which bursts at one end into the bowel and at the other through the skin. It is obvious that either of these actions may be so modified as to give rise to incomplete fistula. Thus, if the matter from the ulcerated opening in the bowel does not make its way through the skin, but after gravitating or

'pocketing' down towards the anus continues to discharge into the bowel, we have the incomplete internal fistula. If the abscess outside the bowel makes its way through the skin, but does not burst into the gut, or if in a complete fistula the internal opening should close (as in Fig. 321), we have the blind external fistula.

The causes of the ulceration of the bowel which leads to fistula are not always easy to trace. It is customary to speak of foreign bodies such as a fishbone, passing through the whole intestinal tract, and then irritating or lacerating the rectum, being detained there by the sphincter, and certainly I once saw a case in which a fishbone was found in a fistula, but such cases are mere curiosities. It is quite possible, however, that either foreign bodies or hardened fæces may irritate this or any other part of the mucous membrane and cause ulceration, and of course this part would be far more exposed to such irritation than any other. In many cases the ulceration seems to be due to the strumous cachexia, and fistula is a well-known complication of phthisis.

Ischio-rectal abscess.

The frequent connection between abscess near the anus and fistula renders the surgeon always anxious to open such abscesses early and very freely, in order to avoid any denudation of the wall of the gut and consequent perforation. The abscess is to be punctured, a director passed into the puncture, and the whole cavity laid open as far as its extremity on either side. If this is early done fistula hardly ever follows.

In examining a case of fistula the first care of the surgeon is to ascertain the condition of the patient's health, and more especially whether or no there are any clear symptoms of phthisis. If the patient be undoubtedly phthisical it is often better not to operate, for the operation is frequently unsuccessful, the wound continuing unhealed up to the time of the patient's death; and the division of the fistula sometimes appears to aggravate the internal mischief, possibly by the irritation and discharge which it causes. But these objections apply chiefly to advanced stages of phthisis. If the disease in the lungs is in an early stage, and the patient is much annoyed by the consequences of the fistula, it is better to operate.

Diagnosis.

It must not be forgotten that every fistulous opening near the anus is not necessarily a fistula in ano, i.e. a sinus originating in or leading to the rectum. I have seen a labial abscess from gonorrhœa, contracted to a sinus, mistaken for a fistula in ano, and fistulous channels in connection with disease of the pelvis not very uncommonly open near the anus. Another very important caution as to the diagnosis of fistula is not to confound with simple fistulæ those fistulous openings which form in connection with stricture of the bowel. Such cases are not rare, and they are overlooked sometimes by people who ought to know better. When the stricture is simple nothing is required for the cure of the fistula but the dilatation of the stricture, just as in perinæal fistula. When the stricture is cancerous no local treatment can do any good. In either case the incision of the fistula is a great mistake. Careful examination of the higher part of the bowel is, therefore, necessary in any case of fistula whose course is obscure, and particularly in those which are multiple and surrounded by a good deal of indurated tissue, as the fistulæ in connection with stricture usually are.

Treatment.

The operation for fistula is one of the simplest possible. It consists merely in passing a director through the fistula and laying its whole track open. But it is often very difficult to find the internal opening, from the sinuous direction of the fistula, or from the small size of the opening into the

bowel compared with the extent of the abscess; for the abscess often stretches to a great distance up the gut, while the internal orifice is close above the sphincter. Often the surgeon may feel the orifice as a small pimple on the wall of the bowel, and if this be on the opposite side of the gut from the external opening, he will discover it by laying open the superficial part of the sinus under chloroform and tracing it carefully step by step around the bowel. But no doubt in some cases (Fig. 321) there is no internal opening, and then the surgeon must make one by pushing the director through the wall of the bowel where it feels most thinned and exposed. Such operations, however, are unsatisfactory. If the internal opening has been overlooked the fistula will surely reproduce itself.

If there be no external opening the internal orifice can usually be seen or felt, and a bent probe can be hooked in it, so that its point projects under the skin. This is then cut down upon, and so the fistula is rendered complete and at once laid open.

There is no necessity for any elaborate dressing after the operation. It is well, I think, to put a piece of oiled lint into the wound, and keep it there twenty-four or forty-eight hours, so as to avoid the agglutination of the superficial part of the wound; and afterwards to pass a probe or director down to the bottom of it, to ensure its filling up regularly; and it is a comfort for the patient if he can be spared any action of the bowels for a few days.

The other methods which have been used for the cure of fistula are the elastic ligature, the electric cautery, and the écraseur. They are much inferior to the cutting operation, but one or other may be used on patients who will not submit to the knife, and I should think the best would be the elastic ligature, but I have no experience of it.[1]



Fig. 322. Fistula in ano. The puckered part represents the anus. A bougie has been passed through the fistula, and the mucous membrane has been removed in order to show the fibres of the external sphincter, outside which the channel of the fistula extends. Below the letter *a* is seen an external pile, which has been cut across. The preparation well illustrates both the cause of the persistence of fistula and the manner in which the operation removes that cause. The director being passed in the track of the bougie above figured, the sphincter is cut completely across, and is then prevented from re-uniting till the track of the sinus below has been obliterated by cicatrisation.—St. George's Hospital Museum, Ser. ix. No. 42.

The cause of the persistence of fistula is doubtless the action of the sphincter ani, which constantly presses upon the walls of the abscess and disturbs any attempt at union. Yet spontaneous cure, in long periods of time, is not unknown. Sir Prescott Hewett mentioned a short time ago at St. George's Hospital two as occurring under his own observation; but the event is too rare and the length of time required too long to afford any valid argument against the advisability of operating whenever the general health will bear it.

[1] I would refer the reader to a discussion at the Clinical Society, reported in the 'Lancet, June 5, 1875, on an interesting case under Mr. Maunder's care of double fistula in the same patient. One was treated by incision, the other with the elastic ligature. The result showed the great superiority of the cutting operation, for the wound made with the knife united kindly and with little pain, while that produced by the elastic ligature was left with callous prominent edges, and did not unite till five weeks after the other was healed. All the surgeons who took part in the debate appeared to be unanimous in condemning the treatment by the elastic ligature as a method for general use, while admitting that it might be indicated under exceptional circumstances, chiefly when the opening is very high and the surgeon has reason

Ulcer or fissure of the anus.

Fissure, or, as it is perhaps better called, ulcer of the anus, is a very painful and distressing complaint, which, however, is usually relieved immediately by very simple treatment. It forms a little crack on the edge of the bowel, hardly implicating the whole thickness of the skin, extending, perhaps, a certain distance up the gut—say half an inch—and situated in the great majority of instances towards the coccyx. An external pile very often forms by the side of the fissure, or possibly the fissure forms at the base of the pile. The fissure is the seat of great pain, especially when the bowels act, and this pain frequently lasts for a long while after defæcation, and is often so severe that the dread of it causes the patient to avoid emptying the gut as long as possible, so that sometimes a very deleterious habit of enforced constipation is set up, which greatly impairs the digestive functions. The obstacle to the healing of this ulcer lies obviously in the connection of the ulcerated skin with the sphincter ani. The cause of the fissure is not always apparent. It is more common in women than men, and may be produced by the irritation of discharges. Cracks form on the anus from gonorrhœal and syphilitic discharges, but are generally more superficial and more easily cured than the proper 'fissure of the anus.'

Some of the milder cases of fissure are amenable to treatment by cleanliness, attention to the state of the bowels, so that the fæces are never hard nor the action costive, and some stimulating application, of which the stick-caustic is the best. But the operation which cures the disease is so simple and affords so much immediate relief that it is seldom worth while to spend time on any other local treatment. It consists simply in exposing the whole extent of the ulcer with a speculum, and then making an incision through its whole length and depth with a stout straight probe-pointed bistoury. This incision should be made carefully, so as to reach the healthy tissue throughout its whole extent. This is usually quite sufficient. If it fails, the division of the entire sphincter (including, of course, the ulcer in the cut) may be necessary. If there is any growth (pile or polypus) near the fissure, it will of course be removed at the same time.

Pruritus ani.

Pruritus ani is often a troublesome affection, and in some cases is so distressing and uncontrollable that, as is the case with pruritus vulvæ, it almost obliges the sufferer to renounce society. Usually, however, it is symptomatic of some disorder of the digestive or sexual organs, and if taken in time is perfectly manageable. Careful attention to the state of the bowels, the expulsion of worms, and the careful regulation of the diet, are the first requisites. It seems to me often to depend on the too free use of stimulants. The local treatment consists of astringent and sedative lotions, with scrupulous cleanliness and perhaps a narcotic at bedtime, when the itching is apt to be severe. Careful examination, however, is necessary to ascertain the absence of fissure of the anus or condylomata, of which pruritus is sometimes only a symptom. The disease is often attended with small excoriations, hardly deserving the name of fissures, around the anus, and the itching will disappear when these are brought to heal, which is usually effected by touching them with nitrate of silver and applying nitrate of silver in solution.

Mr. H. Smith recommends in these cases glycerine ointment—a drachm of

to fear the effect which the necessary division of somewhat large vessels may have on his patient. The ligature has been applied by Mr. Reeves for the cure of fistula in ano in a new way. Having passed a stout twine up the fistula into the bowel he ties it tight till the tissue included in the knot gives way, then a fresh portion is tied, and so on. The plan seems intended to obviate any danger of hæmorrhage and also to humour the prejudice of patients who will not submit to be 'cut.'—'Med. Times and Gaz.' June 15, 1878.

glycerine to an ounce of lard—or an ointment composed of calomel of the same strength (ʒi : ʒi). The black or yellow wash is also sometimes useful, and the daily passage of a bougie will sometimes render the anus less irritable.

Polypus of the rectum.

Polypus of the rectum is a disease which, though not confined to childhood, is most common at that period of life. Two forms of it are described—the vascular and the fibrous—but the difference is one rather of degree of vascularity than of kind, both being formed of fibrous tissue with vessels intermixed.[1] The earlier the age is the more vascular as a rule will be the polypus. These polypi are often attached by long stalks to the bowel, so that when they float up into the gut they are imperceptible and cause no symptoms, but when they are carried down they are grasped by the sphincter, and this causes pain and bleeding. If a child suffers from occasional bleeding from the bowel it is usually from this cause. Piles are very rare in childhood. The polypus, however, may easily escape detection, especially if the bowels have not acted recently. The surest way to detect it is to make the bowels act by an enema, when it will probably present as a small red projection at the anus, or can be felt and drawn down by sweeping the finger round the bowel. Sometimes the surgeon, in so doing, breaks it off and cures the disease, otherwise it is necessary to remove it. There is little or no danger in the less vascular specimens in twisting it off with a pair of forceps; but it is, of course, safer to tie the base and cut it off close to the ligature; and as this gives little if any pain it is the course generally adopted.

Villous tumours.

Villous disease of the rectum is a rare form of tumour, of which, however, I once saw a very striking instance,[2] in which the tumour used to grow to such an extent as to produce some obstruction, from which the patient was relieved by tearing away portions of the mass. This was done thirty-three times, and always with temporary relief. The patient survived five years, and died at the age of seventy. The whole course of the disease in this case, as well as the microscopic examination, showed that the tumour was of a non-malignant nature, though probably in the rectum, as in the bladder, cancerous tumours may be covered with a layer of villous processes. The diagnosis of such tumours when within the reach of the finger or hand will rest on their comparatively slow growth, the villous character of their surface, the absence of hardness at their base, and of any symptoms not explicable by their mechanical pressure.

Mucous tubercles and condylomata.

I ought to mention here—though chiefly for the sake of diagnosis—the syphilitic affections so frequently found near the anus, viz. mucous tubercles and condylomata. Mucous tubercles are often confounded, even at the present day, with external piles. Yet the diagnosis is as easy as possible. Piles are rounded, somewhat pendulous tumours, covered with healthy skin, and only occasionally connected with any symptoms of syphilis, which on careful examination will be found to have nothing but an accidental reference to the disease. Mucous tubercles, on the contrary, form small, perfectly flat, sessile elevations covered with a velvety or warty and moist epidermis, and are always developed in the course of a regular outbreak of secondary or (what is the same

[1] In some of these polypi adenoid tissue may be detected; others consist entirely of epithelium—are, in fact, gigantic warts. A case of this sort is figured in Mr. H. Smith's essay, 'Syst. of Surg.' 3rd ed. vol. ii. p. 865.

[2] 'Path. Trans.' vol. xii. p. 120. The preparation is preserved in St. George's Hospital Museum, and is figured in Mr. H. Smith's essay.

thing) congenital syphilis. I have spoken above (page 388) of the probably contagious nature of their moist secretion, and of the great efficacy of the local and general administration of mercury in their treatment.

Condylomata are generally syphilitic, though they may proceed from the irritation of gonorrhœal and possibly other discharges. They form large pedunculated masses, in which all the textures of the skin can be detected, covered with a foul warty surface and exhaling a fœtid moisture, frequently very vascular, and bleeding to an alarming extent sometimes when removed. The elastic ligature, though inferior in most situations to the knife for the removal of tumours, seems to me very appropriate for the treatment of condylomata.

Stricture of rectum.

Stricture of the rectum is either simple or cancerous. Both will, of course, be accompanied by the same symptoms of mechanical obstruction in proportion to their extent, i.e. constipation, followed by diarrhœa, indigestion, distension of the belly, loss of appetite, health and complexion. These symptoms are not, however, wholly mechanical, though they perhaps are wholly caused by the mechanical obstruction. There can be no doubt that the diarrhœa and the acrid discharge present even in non-cancerous stricture are caused in part at least by retention of the fæces setting up inflammation of the mucous lining of the bowel and catarrhal discharge. In some cases (rarer, however, than might perhaps be inferred from their constant mention in surgical books) foreign bodies become impacted in the strictured intestine and thus complete the obstruction which otherwise would be imperfect.



FIG. 323. Simple stricture of the rectum, at a point about one inch from the anus. The surface of the mucous membrane is much ulcerated, and the walls of the bowel in this situation (which is contiguous to the uterus) are much thickened and indurated. On microscopical examination this thickening was found to be due entirely to the development of a firm fibrous material in the submucous areolar tissue, and in the cellular tissue outside the bowel. No peculiar cell-formations could be detected in this material.—Museum of St. George's Hospital, Ser. ix. No. 37.

Simple stricture depends on the deposit of fibroid material in the wall of the bowel or external to it, probably from chronic inflammation (Fig. 323), or on the healing of ulcers, and these are either strumous, syphilitic, dysenteric, or accidental. Strumous ulcers are believed to be very common. When they perforate the bowel they lead to fistula, and are then usually of small size. Larger strumous ulcers may produce firm bands of cicatrix considerably narrowing the calibre of the intestine (Fig. 325).

So also with venereal disease. Sir J. Paget has shown how common it is in women who suffer from constitutional syphilis to find the rectum occupied by ulcerations of a horse-shoe shape, which in their healing produce cicatricial bands stretching across the cavity.

The main feature in the diagnosis between these simple forms of stricture and the obstruction of cancer lies in the fact that in cancer the morbid deposit is infiltrated for a considerable distance into the walls of the bowel

and the neighbouring tissues, producing a hard irregular nodulated mass which extends for some distance from the seat of obstruction (Fig. 324), while in simple stricture there is often merely a constriction as if a string had been tied round the bowel, the coats of which feel quite healthy up to the stricture; and if the finger can be passed through it, the mucous membrane on the other side feels healthy, and there is no deposit around the bowel.

It must be admitted, however, that the diagnosis is often by no means easy in cases such as that shown in Fig. 325, where the ulcerated and contracted surface is very extensive, and the patient exhausted by suffering.



FIG. 324. Scirrhous deposit and ulceration of the rectum.—Museum of St. George's Hospital, Ser. ix. No. 64.



FIG. 325. Extensive ulceration and contraction of the bowel, with distension above the contracted part, due probably to strumous ulceration.—St. George's Hospital Museum, Ser. ix. No. 49a.

After either kind of stricture fistulous passages will form, precisely as after stricture of the urethra, the wall of the bowel giving way from ulceration above or in the tissue of the stricture, a little of the contents being infiltrated into the textures around, and suppuration extending gradually from this point to the skin. Such fistulous passages, however, form much more readily in cancerous strictures, for obvious reasons, since the substance of these cancerous deposits very readily breaks down and ulcerates; and for this reason also, as well as from their greater extent, the passage of fæces through the stricture is much more painful in cancerous than in simple stricture, and is often the chief source of the patient's misery.

The treatment of stricture of the rectum is in some cases decisive and very successful. When the obstruction is formed merely by an ulcer which has cicatrised, and the constitutional condition on which it may have depended has passed away, the health may be as completely and rapidly restored by dilating the stricture as in the parallel case of stricture of the urethra; and, as in the urethra, this dilatation may be accomplished either gradually, by means of bougies, or rapidly, by incision. The latter method is by no means free from danger. I have seen peritonitis and death follow the incision of a stricture of the rectum even when the incision was quite away from the peritoneal cavity and strictly limited to the posterior wall of the bowel.[1] It should be reserved for dense cicatricial strictures in which the method of gradual dilatation fails or is too painful. It is accomplished by passing a director through the stricture (which is supposed to be too tight to admit the finger) and guiding a hernia-knife upon it, with which the tissue of the stricture is to be slightly notched backwards or towards the sacrum in one or two places to an extent sufficient to admit the passage of the little finger, and therefore of a small bougie. Perhaps the bistouri-caché is a safer instrument. This operation, however, is only intended as a preliminary to the use of the bougie. Although, as I have said before, it is not free from grave risk, in appropriate cases (i.e. cases of tough cicatrix) its beneficial effects are almost magical.

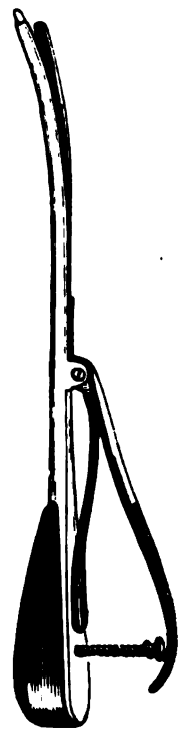


Fig. 326. Bistouri-caché. The instrument is passed through the orifice to be incised, with the knife concealed in the stem. By pressure on the handle the blade is projected to an extent which is regulated by the screw.

Rectotomy.

Still more rapid relief is given by the total division of the stricture and of all the coats of the bowel including the external sphincter (an operation to which American surgeons have given the name of 'Rectotomy')[2] in cases which are appropriate for the operation. What these cases are, our experience of the operation hardly enables us to say at present. In the only case in which I have as yet employed it, it was unquestionably indicated and was rapidly successful. The patient was a woman with a very tight non-cancerous stricture, probably syphilitic, not far from the anus. It was not easy to introduce even a small director through the opening. All inconvenience disappeared and she left the hospital, apparently quite well, within a month. The hæmorrhage if considerable (which it rarely is if the incision is kept in the middle line) may be controlled by plugging the wound with ice. The wound and the bowel should be washed out by copious injections twice a day after the operation, and a full-sized bougie or the finger passed daily from about a fortnight after the incision for an unlimited time.

For slighter cases of non-cancerous stricture the rectum bougie is all that is required. It should be passed at first by the surgeon or by a skilled attendant until the stricture will freely admit an instrument the size of the middle finger and all trouble from obstruction is over, when the patient may be

[1] See Curling, 'Dis. of Rectum,' 4th ed. p. 140.

[2] See Beane, 'Am. Journ. Med. Sci.' April, 1878.

instructed to pass it, and should at first be watched to see that he really does pass it, through the stricture. As in the urethra it will be necessary to keep the stricture dilated for a time which is practically unlimited.

Malignant stricture, on the contrary, can only be aggravated by any form of mechanical treatment. Gentle laxatives, to keep the motions soft and avoid the irritation produced in the upper bowel by the detention of hardened fæces; opium or morphia, to relieve pain and procure sleep; and nourishing food in small bulk, constitute all that can be done in an early stage. Later on the question of affording relief, though only for a time, by opening the bowel above the seat of stricture becomes an urgent one.

Colotomy.

The operation of colotomy is one which has become very common of late, and about which therefore much more is known than was the case formerly. We now know that after successful colotomy, or indeed after the formation of an artificial anus in any part of the intestine, the patient's life is not by any means so miserable as was thought formerly to be the case; and we also know that the cancer which affects the lower bowel is frequently of the less malignant and rapidly-growing forms,[1] and therefore that if the effects of mechanical obstruction and consequent irritation can be obviated the patient may survive a long time. Then, again, the sufferings which cancer occasions when the surface over which the fæces pass is extensively ulcerated are often very acute, and it is worth the patient's while to submit to the risk of the operation even for that cause only, irrespective of any obstruction.

The operation, however, is much more urgently indicated and much more certain to afford immediate relief when it is performed with a view of relieving the symptoms of total obstruction, besides being more easy of execution.

For a description of the operation see the section on INTERNAL STRANGULATION (p. 625).

Colectomy.

An important modification has been introduced recently into the operation of colotomy—viz. the excision of the strictured portion of the intestine (colectomy) when it lies within reach of the operator from the wound.[2] This excision is of course only possible in exceptional cases; but still, according to Mr. Bryant, these cases are more numerous than is generally believed. Two different proceedings may be followed: i.e. the two portions of bowel may be sewn together and returned into the peritoneal cavity, after the removal of the affected part, or they may be attached to the wound, and an artificial anus formed. It seems from Mr. Marshall's paper on the subject ('Lancet,' May 6, 1882) that there were then seven cases on record, and that of these four had been successful, two in which the ends of the bowel had been sewn together, and two in which an artificial anus had been formed. It is of course far too early to give any opinion as to the general applicability of this operation. I may merely add that Mr. Bryant, in a subsequent discussion at the Royal Med.-Chir. Soc., stated that a very considerable extent of intestine could be examined, and if necessary pulled out of the lumbar wound,—as much as five or six inches.

Excision of the end of the rectum.

The lower end of the bowel, or the tissues in the ischio-rectal fossa, or the surface of and around the anus, are not very unfrequently the seat of new

[1] Cancer of the rectum is either of the epithelial or scirrhous form. It often remains for a long time without spreading to the neighbouring viscera, and without much growth or ulceration, if not irritated by the constant passage of fæces.

[2] See Bryant, 'Med.-Chir. Trans.' vol. lxv. p. 131.

formations, sometimes of the nature of epithelioma, sometimes of other forms of carcinoma or sarcoma, sometimes of adenoid or other innocent growths. In such cases the symptoms of obstruction are sometimes severe, and the patient suffers in the same way as in stricture of the bowel; and to these sufferings those of ulceration of the deposit may be superadded. It is for such cases as these that the operation of removing the whole of the lower end of the bowel, along with as much as may be necessary of the parts in the ischio-rectal fossa, was devised, by Lisfranc—an operation which, after having been practised very freely in France by Lisfranc and other surgeons, fell into what I cannot but consider unmerited reprobation, and was almost unknown in our schools of surgery till very lately, when it has been revived and practised with encouraging results by Sir J. Paget, myself, and others in this country, as well as by many operators on the continent of Europe and in the United States. A very interesting work by Mr. W. H. Cripps, on Cancer of the Rectum, contains a full account and criticism of the cases published up to 1879. From this experience, it seems to me certain: (1) that the operation has been successful in relieving the patient from symptoms otherwise incurable, and only susceptible of imperfect relief by colotomy; (2) that many of those who have recovered have lived for a long period, and very probably continued permanently relieved, without any recurrence; (3) that some have regained almost perfect control over the fæces. On these grounds I consider the operation as a legitimate one, and applicable in every case where the morbid growth is fairly within reach of removal, and where it cannot be extirpated without the excision of the whole circumference of the bowel. The proceeding, however, is a severe one, and by no means free from danger. It is very much facilitated by connecting with the incision drawn around the morbid growth which surrounds the anus, a deep incision in the middle line of the ischio-rectal fossa reaching to the coccyx, as recommended by Denonvilliers. Then the parts in front are to be separated from the rectum by a careful dissection conducted along its anterior wall so as to separate it from the prostate or vagina. The incision into the ischio-rectal fossa is to be gradually deepened, by a dissection carried on either side of the bowel to the wall of the fossa, all bleeding vessels being tied, twisted, or cauterised as may be necessary, and the bowel being freed from the coccyx is to be gradually drawn out, till the limit of the disease is fairly reached above and at the sides. When this has been done the gut should be laid open and severed either with the knife, galvanic cautery (cultellum candens), or écraseur, as may be judged best, and the cut end secured in the wound, which is then united as far as necessary. Then the bowels should be kept confined for about a week.

The main dangers of this operation are, hæmorrhage and wound of the peritoneum. Some surgeons conduct most of the deeper dissection with the thermo-cautery, in order to avoid the risk of bleeding, and this may be necessary in dealing with very vascular and rapidly growing tumours; but in general the free exposure of the parts which is secured by Denonvilliers' method enables the operator to take up each vessel as it is wounded. Still the actual cautery ought to be at hand if wanted. Wounding the peritoneal cavity is a still more formidable risk. In the male sex it seems that the reflexion of the peritoneum may be pushed somewhat upwards by injecting the bladder. In the female the surgeon can judge of its position by the finger in the vagina. But in both, the great security against wounding the serous membrane in the deep dissection is to draw the gut down as its attachments

are divided. It does not seem safe to remove more than about two and a half inches in length, though over three inches have been excised without wounding the peritoneum.[1]

Malformations of the lower bowel are usually described as either (1) imperforate anus, or (2) imperforate rectum. 1. In the former case there is no anal opening; in the latter there is, but it does not lead into the bowel. When a child is born with no anal aperture the circumstance may escape notice for a time, and then the symptoms are usually complicated by the useless administration of purgatives. Very commonly, however, the malformation is detected soon after birth. If relief is not afforded the usual symptoms of obstruction set in: after a day or two of constipation the belly becomes distended, vomiting commences (the period being dependent in a great measure on the amount of fluid put into the stomach), the food only being rejected at first, and then the meconium, and the child dies in a few days, either from exhaustion or peritonitis. Many of these cases are, however, perfectly curable, and by so simple a proceeding that it should hardly be dignified with the name of an operation. The bowel comes down close to the skin, and if the surgeon will make a moderately free incision in the position of the anus, draw the bowel down to the level of the skin, and attach the mucous membrane to the skin around the whole of the circumference, nothing more need be done. The patient's life will be preserved for the moment, and it may be confidently anticipated that the power of retaining the fæces will be perfect.[2]

Malformations.

Imperforate anus, properly so called.

These are the simplest cases, and they may be recognised conjecturally by the perfect development of the pelvic bones, so that the coccyx is at the normal distance from the scrotum or vagina, and by the bulging in the perinæum when the child cries. A surgeon who would not operate in a case of this kind would, I think, neglect one of the plainest duties of his profession. Yet many such cases are sacrificed to the prejudice that children with imperforate anus had better be left to die.

There are other cases in which imperforate anus is complicated with fistulæ opening into the vagina, into the bladder or the male urethra, or into the scrotum.

Imperforate anus with fæcal fistula.

When the rectum communicates with the vagina there are cases in which the deformity has produced so little inconvenience that the patient has reached maturity, and even had children, without being sensible of it.[3] In such cases some sphincter action must be exercised by the fibres of the vagina as the gut passes obliquely through them. But generally the patient suffers the most terrible misery from the deformity, and then an attempt must be made to draw the bowel down, as is done in simple imperforation, and at the same time to detach it from the vagina, and this is sometimes successful.[4]

[1] Mr. Cripps lays down four inches as the limit that can safely be removed, and says that rather longer portions can be removed in men than women.

[2] The sphincter exists in some of these cases, though the anus is imperforate. See a dissection by Mr. Partridge, described in the 'Path. Trans.' vol. v. p. 176. But even if there were no external sphincter, the circular fibres of the internal sphincter would prevent any incontinence of fæces. I have mentioned above that even after the removal of the whole of the lower end of the rectum, considerable, and in some cases practically complete, control over the motions may be regained.

[3] A striking case recorded by M. Léon Lefort will be found in my work on the 'Treatment of Children's Diseases.'

[4] Sigr. Rizzoli published several cases in which the deformity had been treated with much success.

When the opening is into the male bladder or urethra, the only thing that can be done to preserve life—which will otherwise be gradually but surely destroyed by the accumulation of semi-solid fæces in the urinary passages, causing symptoms analogous to stone, or absolutely forming the nucleus for a stone—is to open the bowel higher up, either in the loin or groin.

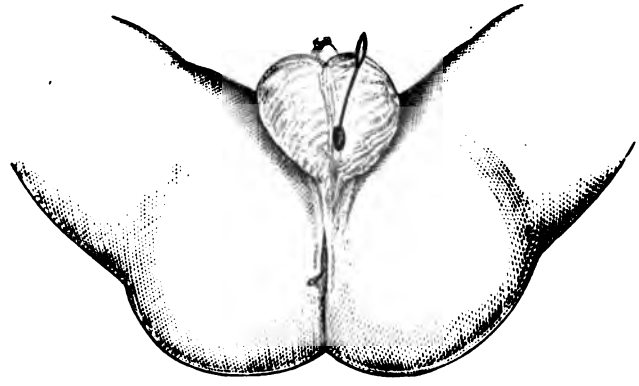


FIG. 327. Imperforate rectum with scrotal fistula. An incision has been made into the rectum from the natural situation of the anus, and a probe passed through this incision from the scrotal fistula. See also Fig. 328.

In cases where external fistula exists the bowel is, I think, never or very rarely far from the integument, and the free re-establishment of the natural passage will cure the unnatural one.

Imperforate anus with deficiency of bowel.

But there are more formidable cases of imperforate anus, in which the bowel is entirely deficient and may terminate at any level, though usually it ends at the sigmoid flexure of the colon, which then sometimes bends over to the right side instead of ending on the left. The deficiency of the rectum may be suspected by the ill-developed condition of the pelvic bones, the tuberosities of the ischia being close together, and the coccyx near to the parts of generation, and by the absence of all bulging in the perinæum when the child cries. The surgeon is, however, justified in making an exploratory incision—keeping very close to the coccyx as he gets deeper—and if he does not find any bowel it is a matter for his own judgment whether to open a higher part of the gut, and if so which part. I cannot doubt that in healthy infants such an attempt to preserve life should be made, and that the groin is the best place to make the opening. Per-

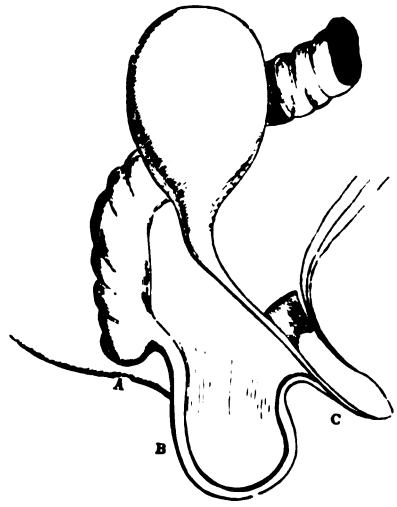


FIG. 328. Dissection of the parts from the above case. The bowel is seen with the bladder lying in front of it. The bowel terminates in a *cul-de-sac*, close to the skin, from which a small canal runs forward. This opens on the skin at B, and from thence an almost imperceptible tube can be traced forwards as far as C, where it opens into the urethra. A marks the situation of the anus, while the incision is shown in the previous figure.—From Larcher. Translation of Holmes's 'Surg. Dis. of Childhood.'

sons in whom this operation (Littre's) has been performed in infancy have been known to live till middle life or beyond it in perfect health and comfort, marrying and taking their part in all the business and pleasures of their station;[1] and though such cases are undoubtedly very exceptional,[2] still I think we are bound to give the patient the chance.

M. Huguier has recommended that in these cases the opening should be made in the right groin instead of in the left, as would seem more natural. His reason is the occasional deviation of the sigmoid flexure to the right side in cases of deficiency of the rectum. But this deviation is after all only occasional. I think it better to make the opening in the left groin; and if the end of the bowel is not found there a slight extension of the wound upwards will probably enable the surgeon to open it as it bends over to the right side.



FIG. 329. Imperforate rectum. The bowel terminates at the middle of the sacrum. There is an anal *cul-de-sac*, separated by a small cellulo-fibrous interspace from the bowel.—After Giraldès.



FIG. 330. Parts removed from a case where Littre's operation was performed by Mr. A. Johnstone, in a case of imperforate rectum, after an unsuccessful exploratory puncture, which passed into the recto-uterine pouch of peritoneum. *a*, the uterus; *b*, a bristle passed in the course of the trocar through the anal *cul-de-sac* into the peritoneal cavity; *c*, the termination of the rectal *cul-de-sac* partly invested with peritoneum, and lying close to the track of the trocar; *d*, the artificial anus in the left groin.—From a preparation in the Museum of the Hospital for Sick Children. Holmes's 'Surg. Treatment of Children's Diseases,' p. 172.

Imperforate rectum, in the strict sense.

2. In imperforate rectum (in the proper sense) the anus and the portion of bowel contiguous to it, which are developed, as the skin is, from the external embryonic layer, are natural, and this almost always causes the deformity to be overlooked at first. But as the child can pass no motions the same symptoms come on as in imperforate anus, and then on examination with the finger the anus is found to lead into a depression, or *cul-de-sac*, like a thimble. The bowel terminates at a variable height above. Usually, as in figs. 329, 330, the lower end of the gut is at no great distance; but the condition of parts may be just the same as in imperforate anus, i.e. the gut may end at the sigmoid flexure or at any higher level.

[1] See Rochard, 'Mém. de l'Acad. Imp. de Méd.' 1859.

[2] Holmes, 'Surg. Dis. of Children,' 2nd ed. p. 173. The more modern experience of these cases, which is certainly also more favourable, will be found in an interesting paper by Mr. H. Cripps in the 18th vol. of the 'St. Barth's. Hospl. Reports.'

The first thing to be done is to make a free incision, through the skin and soft parts, including the *cul-de-sac*, from the coccyx as far forwards as the parts of generation permit, having a staff in the urethra or vagina, according to the sex, so that the bladder, uterus, and peritoneal reflexions may be avoided. The incision should be extended as deep as possible by very gradual dissection, the surgeon feeling constantly for the bulging bowel, and when this is reached he endeavours to draw it down and attach it to the external wound before opening it. This proceeding is much facilitated, according to M. Verneuil, by the resection of the coccyx,[1] which can be accomplished by merely extending the wound backwards and cutting the bone across with a pair of curved scissors. When the bowel cannot be drawn down it must be opened *in situ*, and the patency of the opening maintained either by tents or, what I think is better, by passing the little finger gently through into the gut twice a day. But as these fistulous channels are very liable to close, it is far better, if possible, to draw the gut down.

The old plan used to be to explore the parts with a trocar, but it is an undeniably bad one. The gut may be missed altogether, and the peritoneum or some other part opened (as in the case represented in fig. 330); or if the upper *cul-de-sac* is reached and punctured, the escape of air from it renders it more difficult to dissect down on it afterwards, and no puncture with a trocar, however enlarged by subsequent passage of instruments, gives that free exit for the motions which is necessary in after life.[2]

In many cases the obstruction of the bowel is formed by a mere membrane, and all that is necessary is to make a free crucial opening and keep it distended by the daily passage of the finger for a month, with occasional exploration from time to time afterwards.

The cases of imperforate rectum in which no gut can be found on exploration must be treated on similar principles to those of imperforate anus with the same malformation. In fact, the presence or absence of a small anal *cul-de-sac* is quite immaterial.

[1] See Cripps, 'St. Barth's. Hospl. Reports,' vol. xviii. p. 81.

[2] A most interesting case is reported in the 'Gaz. des Hôp.' June 30, 1877, which shows the lifelong misery and extreme danger to which the method of opening the bowel by a mere puncture may expose the patient. A man, aged forty, died under M. Vulpian's care from an attack of paroxysmal dyspnœa brought on by inability to empty an enormous intestinal pouch, formed by the dilated sigmoid flexure and transverse colon. He had been operated on for imperforate anus, by puncture. This puncture had become cicatricial, intestinal concretions had formed above it, and when the dilated intestine was stopped up by one of these bodies he suffered from terrible dyspnœa, which ultimately proved fatal. So severe was the pressure exercised by the dilated bowel that the vena cava was partly obstructed, and a collateral venous circulation was developed in the walls of the abdomen. All this suffering, and the ultimate death, would have been avoided, if it had been possible at the original operation to stitch the mucous membrane and skin together over a sufficient extent to make a wide and non-retractile anus.

CHAPTER XXXIV.

DISEASES OF THE LARYNX.

Laryngoscopy and rhinoscopy.

THE diseases of the larynx have been brought within the field of actual observation, and their treatment has been rendered certain and successful, by the happy invention of the laryngoscope, an instrument which is usually regarded as the invention of Signor Garcia, an eminent musician, though the late Dr. Babington, of Guy's Hospital, is believed to have a prior claim to the distinction. The late Dr. Czermak was perhaps the one who did more than any other laryngoscopist to perfect the details of the method and to extend and popularise its use. Laryngoscopy has now become so universal that a certain amount of familiarity with it may fairly be expected of every practitioner.

The details of instruments vary considerably, and it would be impossible here to speak of their various advantages. All I shall attempt is to describe the essentials of the method. The laryngoscope consists, then, essentially of two mirrors, one the reflector, which is usually fixed to the forehead of the surgeon, who sits in front of the patient; and the other, the laryngeal mirror or speculum, mounted on a stem, small enough to rest between the tonsils on the lower surface of the uvula and soft palate, and inclined at an angle of 45° to the stem. A powerful lamp is placed behind the patient, unless the direct rays of the sun are avaliable (which is but rarely the case). The speculum is warmed by holding its reflecting or glass surface over the lamp-flame or immersing it in hot water till its back is just warm enough to be comfortably borne on the cheek. If it is hotter the patient's palate will not bear it, if colder his breath will dim it. He is then directed to open his mouth widely, holding the tongue down if he can, and breathing easily. A person who can show the fauces well, and who is not peculiarly sensitive, requires no preparation; and if the surgeon is dexterous at the examination he can lay the speculum on the uvula and direct the light on to it so as to show the image of the larynx on it at once. This image will be reversed, so that the epiglottis and the convergence of the vocal cords appear to be behind and their divergent extremities with the arytænoid cartilages in front, and the right vocal cord is on the left side of the image. Most patients who are examined for the first time require a little preliminary exercise, especially if in the hands of an inexperienced examiner, for practice gives a precision and a gentleness in manipulating the mirror which are invaluable as aids to successful laryngoscopy; and there are many patients whose fauces are so narrow or so irritable that they can hardly tolerate the lightest touch of even the smallest mirror. Still, with patience on the part of the surgeon and perseverance on that of the patient, almost all adults can ultimately be successfully examined. In children it is sometimes actually impossible to obtain a satisfactory view of the parts. The management of the tongue is often very troublesome. After a little practice most patients can keep it out of the way. If not, the patient may hold the tip of it out of the mouth with his handkerchief or a cloth, or the surgeon may depress it with a spatula. The shape of the mirror

seems to me of little importance, though I prefer a round one; but it is of unquestionable advantage to use as large a one as the fauces can tolerate.

With the laryngoscope all the back of the mouth and fauces can be thoroughly examined, and in the mirror the epiglottis, arytæno-epiglottidean folds, the apices of the arytænoid cartilages surmounted by the cornicula, the openings of the ventricles, the true vocal cords, and a part of the wall of the trachea (while the glottis is open) can be fully seen. In some cases where the cords are widely apart an experienced examiner can direct the light so as to catch the bifurcation of the trachea.[1] When the parts are fully in view the patient is directed to pronounce the vowel 'Ah' in tones varying from the lowest to the highest pitch of his voice, so as to throw the vocal cords into free vibration, and show whether they are as movable and as elastic as they should be; their outline is carefully examined for the marks of ulceration or other injury; vegetations on the cords or tumours of any other kind in any part of the larynx, or foreign bodies, can hardly escape observation; and any deviation from the natural colour of the various parts will be readily appreciated by one who has accustomed himself to the examination of the parts in health. This is, indeed, indispensable. No description or book of plates will enable a surgeon to recognise morbid appearances unless he has habituated himself to the aspect of the parts in health, which is perhaps best done by auto-laryngoscopy at first, though it is also very necessary to examine a variety of individuals, in order to learn the way of overcoming the difficulties caused by varying idiosyncrasies, which can only be done by various little changes in manipulation. Success in laryngoscopy can only be obtained by constant practice, and this is still more necessary in order to succeed in the delicate manipulations by which some affections of the larynx must be treated.

Rhinoscopy.

The posterior nares and upper part of the pharynx can also be illuminated more or less completely by means of the laryngeal speculum, but the view obtained is far less satisfactory; still, enough can in many cases be seen to enable the surgeon to diagnose with confidence affections which would otherwise be only matters of inference.

The instruments are the same, with the addition of a long narrow spatula turned up at the end, or a blunt flat hook, by which the uvula and soft palate are to be gently raised and drawn forward with the left hand, while the mirror, which is somewhat smaller and longer in the stalk than the common laryngoscopic speculum, and has the stem a little bent downwards near its junction with the handle, is passed to the back part of the pharynx. By slight variations of its position and of that of the reflector the surgeon tries to bring successively into view the various parts of the naso-pharyngeal region. Mr. Durham says: 'Under favourable circumstances the two superior meatuses may be inspected and considerable portions of the mucous membrane covering the turbinated bones and the septum may be seen; the posterior surface of the velum may be examined and if the mirror is turned towards one side, the lateral wall of the naso-pharyngeal cavity and the orifice of the Eustachian tube may be brought into view. But the difficulties of posterior rhinoscopy are great, and it is rarely that the cavities may be inspected to the extent indicated, although this is theoretically possible in most cases, and has been actually accomplished in many.'[2]

[1] I think Prof. Czermak was the first to show this on his own person, but many demonstrators of auto-laryngoscopy have been able to follow his example.

[2] 'Syst. of Surg.' 3rd ed. vol. ii. p. 633.

When the laryngoscopical appearances in health and those in disease to a certain extent have become familiar, the surgeon proceeds to learn the use of the laryngeal brush and the stem by which solutions or solid substances are conveyed to any accessible point of the larynx which may be desired; and that of the forceps, laryngeal scissors, or guillotine, by which new growths may be removed.

Laryngitis occurs either in the acute or chronic form. In the former it is a most formidable affection, very dangerous to life, and often proving fatal in spite of the most vigorous and judicious treatment. Its causes are exposure to cold (acute catarrhal laryngitis), the poison of the contagious fevers, small-pox and scarlet fever especially, doubtless from the extension to the mucous membrane of the characteristic affection of the skin (exanthematous laryngitis), the extension inwards of cutaneous or phlegmonous erysipelas (erysipelatous and diffuse cellular laryngitis), and injury (traumatic laryngitis). Chronic laryngitis may also be catarrhal, or phthisical (strumous), or syphilitic, or it may result from over-use of the voice (clergyman's sore-throat, chronic glandular or follicular disease of the larynx). Laryngitis.

Besides these affections, which are found at any time of life and localised in the larynx, there must be added to the list of acute affections the peculiar spasmodic inflammatory affection in children called croup, and the diphtheritic affections of the throat which spread downward into the air-passages.

It would be out of place here to attempt a complete view of the affections of the larynx. I must content myself with a general summary of the more important practical points connected with its acute and chronic diseases, referring the reader for more extensive details to Mr. Durham's excellent essay in the 'System of Surgery,' revised by Mr. Hensman, or to some of the special treatises on the subject.

Acute laryngitis is characterised by the sudden accession of formidable obstruction, very liable to be complicated by attacks of spasmodic dyspnœa (spasm of the glottis), in which life may easily terminate. The rapidity with which the disease proves fatal in some cases is well known. I have known a man, tolerably well in the early afternoon, who died four hours afterwards; nor are such cases very rare. The complaint begins with ordinary sore-throat (and probably the catarrhal form usually commences in the pharynx), then feverishness and distress supervene, inspiration becomes difficult and painful, with some cough; dysphagia increases, the patient begins to hawk up small hard masses, which are supposed to come from the ventricles of the larynx; then the dyspnœa rapidly increases, expiration as well as inspiration is obstructed, the face becomes livid, the features bathed in sweat, the pulse small and intermittent, and death follows either from spasm of the glottis, from sudden suffocation without spasm, or from more gradual obstruction preceded by unconsciousness. Acute laryngitis.

The treatment of this formidable disease must necessarily be vigorous and decisive if the patient is to have any chance. In the first stage, when dysphagia and dyspnœa, for which there is no other cause present, point to the spread of pharyngitis over the epiglottis to the larynx, a careful inspection of the fauces (with the laryngoscope, if the patient can tolerate it, if not with as good a light and as free an opening of the mouth as can be procured) is essential; and if, as will probably be the case, the parts about the arytæno-epiglottidean fold are found congested and thickened they should be very freely scarified. At the same time antimony and aconite should be given in

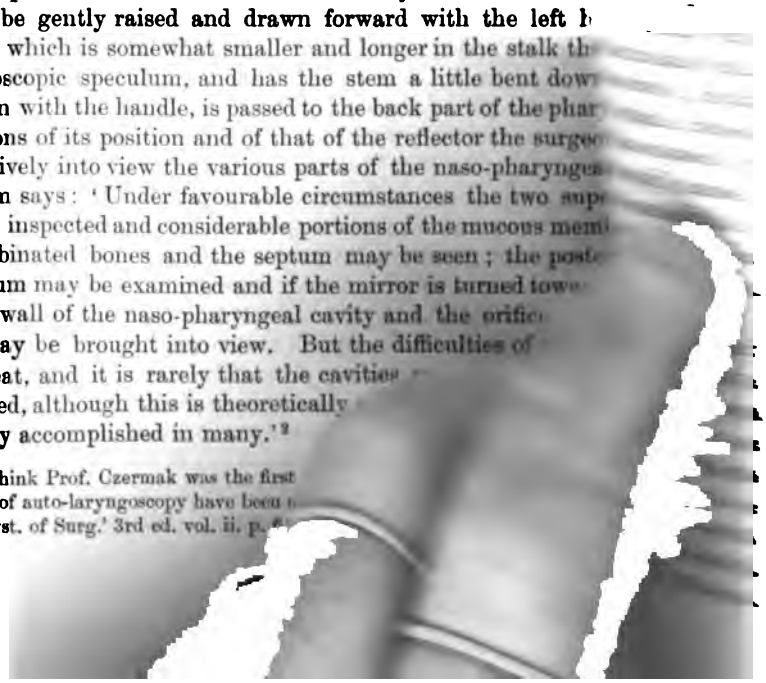
seems to me of little importance, though I prefer a
unquestionable advantage to use as large a one as th

With the laryngoscope all the back of the mo
thoroughly examined, and in the mirror the epiglottis
folds, the apices of the arytænoid cartilages surmou
the openings of the ventricles, the true vocal cords, a
of the trachea (while the glottis is open) can be fully
where the cords are widely apart an experienced exa
light so as to catch the bifurcation of the trachea.[1]
fully in view the patient is directed to pronounce the
varying from the lowest to the highest pitch of his voic
vocal cords into free vibration, and show whether they
as elastic as they should be; their outline is carefull
marks of ulceration or other injury; vegetations on the
any other kind in any part of the larynx, or foreign bodi
observation; and any deviation from the natural colour o
will be readily appreciated by one who has accustomed him
tion of the parts in health. This is, indeed, indispensab
or book of plates will enable a surgeon to recognise
unless he has habituated himself to the aspect of the parts
perhaps best done by auto-laryngoscopy at first, though it is
to examine a variety of individuals, in order to learn the
the difficulties caused by varying idiosyncrasies, which ca
various little changes in manipulation. Success in laryng
obtained by constant practice, and this is still more nec
succeed in the delicate manipulations by which some affect
must be treated.

Rhino-scopy.

The posterior nares and upper part of the pharynx ca
nated more or less completely by means of the laryngeal s
view obtained is far less satisfactory; still, enough can in m
to enable the surgeon to diagnose with confidence affectio
otherwise be only matters of inference.

The instruments are the same, with the addition of a lon
turned up at the end, or a blunt flat hook, by which the uvul
are to be gently raised and drawn forward with the left h
mirror, which is somewhat smaller and longer in the stalk th
laryngoscopic speculum, and has the stem a little bent dow
junction with the handle, is passed to the back part of the phar
variations of its position and of that of the reflector the surge
successively into view the various parts of the naso-pharynge
Durham says: 'Under favourable circumstances the two sup
may be inspected and considerable portions of the mucous mem
the turbinated bones and the septum may be seen; the poste
the velum may be examined and if the mirror is turned towa
lateral wall of the naso-pharyngeal cavity and the orific
tube may be brought into view. But the difficulties of
are great, and it is rarely that the cavities
indicated, although this is theoretically
actually accomplished in many.'[2]



[1] I think Prof. Czermak was the first
strators of auto-laryngoscopy have been

[2] 'Syst. of Surg.' 3rd ed. vol. ii. p.

ea has become very
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s, often very
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tomy,[1] but by
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od deal on the
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ch the mere spasm has been so
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ngly rare one.



small but frequent doses.[1] If the inflammatory appearances are less decided, the patient should be enclosed in a warm, moist atmosphere, and the throat should be constantly steamed with simple steam, or the same mixed with henbane or hops; or the inflamed membrane may be carefully pencilled with a very strong solution of nitrate of silver (ʒi to ʒi).

But if, as too often happens, the symptoms advance, tracheotomy, or laryngotomy, must not be delayed. Unfortunately it seldom saves the patient's life; but it is his only chance, and the earlier it is performed the better for him. There is no necessity for opening any part of the tube lower than the cricothyroid interval in these cases. Sir P. Hewett has shown that the œdema never extends below the vocal cords, so that the ordinary operation of laryngotomy will give the patient the means of breathing, but in most of the cases I have seen he has sunk nevertheless. In many of these instances, especially when occurring in later life, the kidneys will be found diseased; otherwise I do not know how to account for the fatality of the affection. After the opening is established I do not think any further employment of depressing remedies is indicated. The pulse and temperature should be watched, and the patient supplied with stimulants and nourishment in accordance with his condition.

The above refers to the catarrhal form of acute laryngitis. In the exanthematous forms no scarification and no depression should be thought of. The only question is, whether tracheotomy will give the patient any further chance of survival.

When erysipelas in either of its forms extends inwards to the larynx the complaint is usually fatal. Still, instances of successful tracheotomy are not wanting, and the operation should not be long delayed.

In traumatic cases, as I have stated above (page 185), the operation should always be performed early, when there are loose portions of cartilage hanging into the larynx, or the mucous membrame has been penetrated by the edge of a fracture. For the treatment of laryngitis which follows burn or scald I would refer to page 191.

Croup, or cynanche trachealis.

The acute laryngitis of croup is not preceded by pharyngitis, as the common catarrhal laryngitis is, nor is there any diphtheritic or croupous membrane in the pharynx or mouth, as there is in diphtheria. Still, the resemblance or relationship between croup and ordinary laryngitis on the one hand and diphtheria on the other is very close, so that many authorities regard croup and diphtheria as essentially the same disease—an opinion which is strengthened by observing that in epidemics of croup there are cases in which the false membrane does extend into the fauces, and which are called 'diphtheritic croup.' Croup sets in with feverish symptoms and a hard, dry, ringing cough, without dysphagia, but soon running on to considerable dyspnœa, aggravated into formidable paroxysms, and accompanied by cough and expectoration, in which very commonly shreds of false membrane may be observed. Inflammation rapidly extends down the trachea to the bronchi, the breathing becomes more oppressed, so that the sides of the neck are seen to be drawn in during inspiration, the face becomes livid, consciousness oppressed, and the child dies asphyxiated.

In this formidable disease there are two stages to be considered in the

[1] Mr. Durham prescribes two or three minims of the Vin. Ant. with one or two drops of Tinct. Aconit. (B. P.) and half a drachm of Liq. Ammon. Acet. in some vehicle every quarter or half hour till some obvious effect has been produced on the pulse, and then the same less frequently.

treatment—the first that which occurs before the dyspnœa has become very dangerous, when there is sufficient evidence of acute laryngeal inflammation spreading down the trachea, but the breath still comes pretty freely. In such cases anatomical examination would show the larynx inflamed, and more or less coated with a fibrinous or leathery exudation, which extends some distance down the trachea, but does not line the whole of it nor reach the lungs. During this stage emetics, leeches to the chest, and the free use of antimony are the measures indicated. Some practitioners rely much on mercury, on account of its solvent action on fibrinous exudations; but, as Dr. Barclay has pointed out, that action is too slow to be available in croup. At the same time mercury may be combined with antimony, on which latter drug, no doubt, the chief reliance is to be placed. Warm fomentation, with opiate liniment to the throat, and the creation of a warm, moist atmosphere round the bed, are decidedly useful. Most cases of croup are thus brought to a favourable issue. But in the second stage, when the respiration is very laboured, and the subclavicular spaces are seen to be depressed in every effort at breathing, when the child is becoming livid and oppressed, yet the lungs are not much loaded, tracheotomy becomes urgently necessary. At this period it will be found that the glottis is extensively trenched upon by the exudation which now nearly fills the larynx, and which is beginning to extend beyond the bifurcation of the trachea. If the operation is delayed till the lungs also become much loaded it is useless to perform it.

Opinions differ as to the place which should be selected for the operation. My own is in favour of operating above the thyroid isthmus; for though, if we could make sure of getting below the lower end of the inflammatory membrane, it would no doubt be worth some risk and trouble to attain this object, yet the extra half or three-quarters of an inch which is the distance between the incisions in the two operations is quite useless for this purpose, while the operation below the thyroid isthmus is in a fat child a very dangerous one.

The more the disease approaches to pure diphtheria the less is the prospect of relief from tracheotomy, though the chance of relief should not be refused, as numerous examples of recovery have been recorded, even when the patient's condition has been regarded as desperate.

Laryngismus stridulus.

Clearly distinguished from croup or diphtheria is laryngismus stridulus, or 'child-crowing,' a spasmodic affection allied to convulsions, often very alarming, but accompanied by no general fever and by no exudation, therefore having intervals of perfect remission, and to be treated, not by the administration of depressing remedies, still less by tracheotomy,[1] but by bringing the child slightly under the influence of chloroform when the spasm comes on; or, if the spasm is not very powerful, by the use of the warm bath.

The success of tracheotomy in croup will depend a good deal on the period at which it is employed. If the surgeon resorts to the operation early, and is dexterous in its performance, a large proportion of his patients will recover; but then a good many of these would certainly have recovered without. Nothing seems to me to show the fallacy of statistical reasoning in matters of practice more than the conclusions hastily drawn from the great apparent success which attends the operation of tracheotomy for croup in the hands of surgeons who perform that operation very frequently. Without denying that an early resort to tracheotomy *may* be better practice than

[1] There are, it is true, a very few exceptional cases in which the mere spasm has been so severe as to prove immediately fatal; and here it is necessary to open the trachea, if the surgeon happens to be present; but the occurrence is an exceedingly rare one.

Chronic laryngitis. Phthisical.

waiting till the child is nearly *in extremis*, I would point out that this conclusion rests on observation, and cannot be proved by quoting numbers.

The constitutional forms of chronic laryngitis are all marked by the prominent symptom of aphonia rather than by any danger to life, though any of them may become dangerous to life when complicated with ulceration, since that ulceration may irritate the vocal cords and produce spasm of the glottis, or may extend to the cartilages, and portions of the necrosed cartilage may become displaced or entirely loose and act as a foreign body.[1] In 'phthisis laryngea' the disease consists, as it seems, in the development of tubercle beneath the mucous membrane of the epiglottis and larynx, which runs on with more or less rapidity to ulceration, leading to loss of voice, destruction of the epiglottis, dysphagia, cough, expectoration, necrosis of the cartilages, and death. As a general rule the disease in the larynx is only a part of the general affection, and the patient's death is due to the disease in the lungs; but in other cases the complaint commences in the larynx, and may, indeed, be confined to it. The treatment of the disease must, of course, be regulated by the general condition. When the lungs are profoundly affected nothing can be done beyond soothing the patient's sufferings by steaming the larynx from time to time with hot water mixed with henbane or stramonium, touching any ulcers which may be visible on laryngoscopic examination with a wire coated with nitrate of silver or with a solution of nitrate of silver on the laryngeal brush, and enjoining rest to the laryngeal organs as much as possible. Even in these hopeless cases, however, Mr. Durham urges the occasional justifiability of tracheotomy as a palliative, if the patient is greatly troubled by pain or difficulty of breathing; while there are doubtless cases in which the laryngeal disease is the essence if not the whole of the complaint, and in which tracheotomy is urgently indicated.

Syphilitic laryngitis.

Syphilitic laryngitis is either secondary or tertiary, and the affections of the larynx appear to bear a general resemblance to the secondary and tertiary phenomena of syphilis in other parts of the body. Thus the secondary laryngitis seems to depend usually on the spread of roseola or psoriasis from the throat, or on the development of similar affections, or of mucous tubercles, on the laryngeal mucous membrane. Secondary ulceration may also spread from the fauces down to the larynx, and may either destroy the vocal cords partially or completely, or may so displace and bind them down as to prevent their proper action, and so lead to permanent aphonia.

Secondary laryngitis as a rule involves no worse consequence than loss of voice, which is usually only partial and temporary, though when ulceration or inflammation occurs in the neighbourhood of the cords the patient is, of course, never free from the danger of spasm.

The tertiary affections of the larynx are more deep and more dangerous. Some of them seem to consist in warty growths in the larynx, not unlike the syphilitic vegetations or condylomata found elsewhere; but the chief tertiary affection of the larynx is ulceration, which rapidly extends to the cartilages and vocal cords, destroying the larynx as an instrument of voice and producing the most serious danger to life.

Syphilitic affections of the larynx can usually be diagnosed from other diseases by concomitant symptoms; but in any case of doubt the effect of anti-syphilitic remedies will assist the diagnosis. The exhibition of mercury in the form of calomel vapour, inhaled through a mouthpiece attached to

[1] There is even a case on record in which a diseased gland made its way by ulceration into the trachea, and a portion of it dropped into the tube, producing the usual symptoms of foreign body.

the common mercurial lamp, or the repeated application of the Liq. Hyd. Perchlor. pure or diluted with an equal bulk of water, are the most useful applications in syphilitic sore-throat. In secondary affections the patient should undoubtedly be brought fully, though gradually, under the influence of mercury. In the tertiary stage of the disease iodide of potassium with tonics may be given internally while the local mercurial treatment is being carried on. In these, as in all other ulcerative diseases of the larynx, the surgeon must be prepared for the necessity of tracheotomy, and must not let his patient die, or run any serious danger of dying, for the want of an opening through the cricothyroid membrane.

Follicular laryngitis. Dysphonia clericorum.

The follicular disease, or dysphonia clericorum, has its seat in the glandules or follicles of the mucous membrane, and is often accompanied by a similar affection of the mucous membrane around. 'The membrane covering the arytænoid cartilages and immediately adjoining parts is more rich in glandular structures than any other portion of the laryngeal mucous membrane. Now, this part is constantly subject to a very great extent of motion, and also perhaps to considerable strain, during forced vocalisation.'—(Durham.) Thus is explained the prevalence of this complaint in those whose occupation leads to constant exertion of the voice, though it occurs in others also: in photographers according to Gibb, who are exposed to acrid chemical fumes; and in persons labouring under the herpetic diathesis, according to Trousseau and others.

'The symptoms are: alteration of the voice and sense of effort in sustaining it—these are by far the most prominent and constant symptoms; more or less discomfort about the larynx, never amounting to pain, but occasionally troublesome; dryness and sometimes a sense of heat about the throat; and constant desire to clear the throat by "hemming" and "hawking." There is little or no regular cough; and the expectoration which sometimes occurs is slight, scanty, and mixed with saliva. There is neither difficulty in swallowing nor tenderness upon pressure over the larynx. There are no definite constitutional symptoms, but the general health and spirits of the patient are often observed to be more or less depressed.'[1]

The voice is much affected in these cases, and especially in distinct or loud speaking or reading. The mucous membrane of the fauces and throat as well as that of the larynx is seen in the early stage of the complaint studded with enlarged glands, surrounded by an area of redness, and at a later period these may have formed small points of ulceration; but it does not seem that the deeper structures are liable to disease or that the larynx is ever incurably disorganised.

The local treatment consists in the persevering application of astringents, nitrate of silver, tincture of iodine, sulphate of zinc or copper, in such strength as is found to be suitable, touching the ulcerated parts with the solid nitrate of silver, and the inhalation of pulverised solutions of 'common salt, chloride of ammonium, iodide of potassium, and in some cases alum or weak solutions of perchloride of iron.' Mr. Durham says also that benefit may be derived from sucking medicated lozenges (chloride of ammonium, with or without cayenne, and the 'red gum lozenges'), and from wearing the beard. The general health must be carefully attended to, and the patient may be comforted with the assurance that though the treatment may be tedious there is every reason to hope ultimately for complete success.

[1] Syst. of Surg.' 3rd ed. vol. ii. p. 674.

Tumours of the larynx.

The diagnosis of tumours of the larynx is due exclusively to the laryngoscope. Formerly, though the existence of such tumours might be guessed at, it could never be affirmed. Now they can be seen, and, what is of far more importance, they can often be removed without any incision or any inconvenience whatever, and the patient in some instances restored to the full use of the voice, and in all rescued from the imminent danger of suffocation which is incident to the presence and growth of a tumour in the neighbourhood of the glottis.

Most of the tumours which affect the larynx are common warts or papillomatous growths,[1] which spring up from any part of the mucous membrane, sometimes in considerable number, and often grow to a very large size. They are sometimes congenital. They are said to spring more commonly from the front of the larynx, near the convergence of the vocal cords, though they may grow in any part of the cavity of the larynx, or even in the trachea.[2] Fibrous and fibrocellular tumours are next in number, some of which are sarcomatous and grow rapidly; others are pedunculated, like the polypi of other parts. Adenoid growths are rare, and grow from the base of the epiglottis, the arytæno-epiglottidean folds, or the membrane covering the epiglottis. A few instances of cystic, cartilaginous, and osseous tumours are also recorded. These are the innocent forms of tumour—the cancerous growths are mostly epitheliomatous, though instances of soft cancer are not wanting. Epithelioma is generally an extension from the pharynx; but it sometimes begins, as Mr. Durham describes it, on the mucous membrane lining the back of the cricoid cartilage, and doubtless in other parts of the larynx also, in the form of small irregular nodules, which gradually increase in size and soon ulcerate. In any case the tumour will soon present an ulcerated surface, and can then be recognised from the other forms of ulceration by its elevated edge, by its dirty grey colour, by the amount of new deposit, causing irregular thickening in the parts around, and in some cases by the presence of enlarged glands.

The symptoms caused by a tumour of the larynx are the same as those accompanying any other chronic affection, viz. aphonia, more or less complete; hoarseness, cough, occasional dyspnœa, sometimes aggravated into fits of spasm, and in some cases (chiefly those of cancer) more or less dysphagia. The more movable and pedunculated the growths are, the more liable are they to cause spasm of the glottis, while the degree of permanent obstruction of course will depend mainly on the size of the growth.

The diagnosis can only be arrived at by laryngoscopy, unless in the rare instances (chiefly in childhood) in which the growths can be felt by passing the finger round the epiglottis.

The treatment of a tumour of the larynx is directed to fulfil two different indications, viz. either to remove the growth altogether or to protect the patient from the danger of suffocation by tracheotomy. Of the performance of laryngotomy or tracheotomy, in order to avert suffocation by a tumour, I need say nothing further; the indications are the same as in spasm of the glottis, or alarming dyspnœa from any other cause. There are various ways

[1] Out of 244 cases of laryngeal tumour collected by Mr. Durham 110 were of this nature—19 only were cancerous.

[2] See a very interesting case recorded by Mr. Butlin in 'St. Barth's. Hospl. Reports,' vol. xviii. p. 129, in which a large papillomatous tumour was successfully removed by tracheotomy. It was 'attached below the cricoid cartilage, to nearly half the circumference of the trachea and for more than an inch downwards on the left side.

of removing laryngeal tumours. There may be small warty elevations hardly deserving the name of tumours, yet quite sufficient, if seated on the cords, to produce aphonia, and which may be repressed by touching them with the nitrate of silver, fused and applied to the end of a bent wire, or by means of a wire carefully conveyed down to them and connected with a galvanic battery; but this last manœuvre is a very delicate one, and the surgeon must first well exercise himself and his patient to see that he can always bring the wire into unfailing contact with the little growth.

Removal from the mouth.

More commonly, however, the growths which are large enough to produce symptoms are also large enough to be seized and removed by delicate forceps of appropriate shape and construction, or by a snare or écraseur, constructed on the same principles as Hilton's snare for nasal polypi, figured on p. 609, with the necessary modifications in size and shape; or by a knife, scissors, or guillotine, i.e. an instrument which is slipped over the tumour, when pressure on a handle projects a blade which cuts it off. Laryngeal growths have also been removed by the galvanic cautery, though the method seems unnecessarily dangerous, and those which are cystic have disappeared after simple puncture.

In all cases where it is possible the method of removal from the mouth ought to be adopted. But sometimes, from the age of the patient, from his intolerance of the necessary manipulation, or from the size and attachments of the tumour, it may become necessary to remove it by external incision.

Thyrotomy.

Thyrotomy, as the operation is called, is an extension of laryngotomy, the incision into the larynx being continued upwards between the alæ of the thyroid cartilage. It is best done, I think, at two different sittings. The usual opening having been made through the cricothyroid membrane, the patient is relieved from all danger of suffocation, and the common tube is introduced. Then, at a subsequent day, a tampon-tube is introduced and the windpipe securely plugged (the patient being, of course, fully narcotised, which is readily effected by administering the anæsthetic through the tube), and the incision is slowly and cautiously carried along the middle line of the pomum Adami, so as to wound neither vocal cord, till the thyrohyoid membrane is reached. I think it will often be found more convenient to commence the incision above at the notch between the two halves of the thyroid cartilage, and prolong it downwards very steadily and carefully in the middle line till the tracheotomy wound is reached. A couple of blunt hooks will now drag the two halves of the larynx apart. If there is much bleeding (as there often is) a piece of sponge must be firmly pressed into the larynx till it has subsided. The patient is all this time breathing quietly through the tampon-tube. On the subsidence of the bleeding the whole interior of the larynx, with the mouths of its ventricles, will be exposed, and the tumours can be cut away, their bases cauterised, and any other manipulation carried out most satisfactorily. The same proceeding is sometimes required for the removal of foreign bodies impacted in the ventricle (see p. 189), and under urgent circumstances it is of course performed at one sitting.

Extirpation of the larynx.

Latterly, still more extensive operations have been practised for malignant and other extensive diseases of the larynx, all the parts affected having been removed, so as to extirpate the whole larynx and lay the pharynx freely open. The only experience I have had of this formidable operation is that of one case under Mr. Pick's care,[1] at which I assisted. In that case I thought the operation justifiable, as the patient was evidently sinking, and

[1] 'Clin. Trans.' vol. xiv. p. 163.

as there was considerable doubt whether the disease was not innocent in its nature, and it appeared possible to remove it entire. In such cases it seems reasonable to give the patient the chance which the operation may hold out; while in cases obviously of a malignant nature, the propriety of extirpating the larynx is very dubious, since the disease will almost certainly recur very soon, and the immediate risk to life is extremely great. Yet perhaps the surgeon may in some cases be justified in yielding to his patient's wishes, if he is suffering much from the disease and urgently presses for its removal.

The operation in the case referred to was thus performed. Tracheotomy having been practised on a former day, the trachea was completely plugged with Semon's modification of Trendelenburg's tampon, and all risk of suffocation from blood running into the windpipe thus averted. Then the parts over the thyroid cartilage were freely divided by a crucial incision and the thyrohyoid membrane denuded and incised on one side as far as the upper cornu of the thyroid cartilage, which was then severed from the hyoid bone. The lower cornu was then separated from the cricoid cartilage, and the thyroid and cricoid cartilages divided in the middle line. One-half of the thyroid was then removed, and afterwards of the cricoid. Then the other side was similarly treated, the whole operation being performed with curved blunt-pointed scissors. In this way all the vessels divided (which were few and small) were secured at once with clips, and hardly any blood was lost. No vessels required a ligature. The pharynx was of course widely opened in removing the posterior part of the cartilages.

Dr. Morrell Mackenzie has collected 19 cases in which the larynx has been extirpated—in 16 cases for cancer. Of these eight died, and of the rest recurrence took place rapidly in seven—the other was free from recurrence seven months after the operation. In two cases where the disease was classed as 'sarcomatous,' one was quite well three years after the operation, and the other remained free from recurrence for 18 months and then died of phthisis.

The operation seems most appropriate for cases of diffused papillomata, such as Mr. Pick's was judged to be; but more experience is required before we can speak decisively as to its indications.

After recovery an apparatus can be adapted, in the place of the larynx, consisting of a box with a vibrating tongue inside, by means of which the patient can articulate very completely—at least quite sufficiently for practical purposes.

In connection with these operations for the removal of parts of the vocal apparatus, I ought to mention a case related by Mr. Lister and Dr. B. Yeo to the Clinical Society,[1] in which, after thyrotomy, Mr. Lister removed the whole of the true vocal cords along with some warty growths, and the patient recovered the power of complete and even loud articulation, his voice being perfectly audible over a tolerably large room. Mr. Lister attributed the restored voice to the vibration of the arytæno-epiglottidean folds.

Aphonia, nervous and hysterical.

Aphonia, besides being a symptom of all chronic laryngeal disease, occurs also from causes unconnected with any disease in the larynx. The nervous or hysterical aphonia, which is often seen in young women—though sometimes in men—is an affection not very well understood, and sometimes devoid of any other symptom of hysteria or nervous disease, though agreeing with such disorders in the fact that there is no visible degeneration of tissue in the

[1] 'Clin. Trans.' vol. xi.

parts affected, and that the function may often be completely and immediately restored without any visible cause for the change.

In a case of this kind laryngoscopic examination will show all the parts of their natural appearance, but the motion of the cords is variously affected. The voice sometimes appears and disappears quite suddenly, and in all cases there is the same want of proportion between any recognisable cause and the presumed effect which is noticeable in other 'nervous mimicries.' There may have been some little cold or some extra exertion of the voice alleged as the cause, but this is wholly insufficient to account for a total inability to speak.

These cases often get well of themselves, or any method of treatment may cure them—the mere introduction of the laryngoscope has produced a return of the voice.[1] The approved methods of treatment seem to act by giving the patient a shock—a 'shake-up,' as Mr. Durham terms it. Such are the pinching or squeezing of the larynx, the application of galvanism either to the cords themselves or to the parts near them, the application of strong or irritating lotions to the interior of the cavity, such as solutions of nitrate of silver or sulphate of copper, and the application of irritating fumes, as those of solutions of ammonia or chlorine.

Aphonia is said also to result from idiopathic atrophy of the muscles of the larynx, but on this head little, I believe, is known.

Aphonia, from paralysis.

Usually, when a patient has lost his voice and on laryngoscopic examination one of the vocal cords is seen to be motionless, the cause is to be sought in pressure on the recurrent nerve, and the commonest cause of that pressure is either an aneurismal tumour, especially aneurism of the aorta pressing on the left recurrent, or an enlarged gland, or a malignant tumour in the thorax or neck. It is not very uncommon for a person to be unaware of the existence of aortic aneurism until the attention of his physician is called to the part by either paralysis or spasm of the glottis. And there seems good reason to believe that the pressure of a tumour on any part of the windpipe may set up irritation in its substance which may be so reflected down the nerves of the part as to produce either paralysis or spasm of the cords without any direct interference with the nerve-trunks.

Spasm of the glottis.

Spasm of the glottis is one of the most painful and most fatal of all surgical accidents. It comes on from the most various causes, and may terminate life in a few minutes, if prompt help be not given. That help lies in the immediate opening of the windpipe below the glottis; and when, as sometimes happens, a patient is found in obvious and imminent danger of death from spasmodic dyspnœa, of the cause of which the bystanders can give no account, the surgeon's duty is to make an opening at once through the cricothyroid membrane, and if necessary perform artificial respiration through the opening. But what has been said above is sufficient to show that in many cases of spasm of the glottis the immediate opening of the windpipe is unnecessary, and fortunately it is only in rare emergencies that we have not the opportunity for more deliberation in the treatment.

The chief causes of spasm of the glottis have been pointed out in the foregoing pages. They are: foreign bodies fixed in the larynx or loose in the lower part of the windpipe when they impinge on the cords, burns and scalds of the larynx, inflammation and ulceration (whether acute or chronic) trenching on the neighbourhood of the cords, tumours when they

[1] See Durham, in 'Syst. of Surg.' 2nd ed. vol. iv. p. 592.

move so as to get between the cords, aneurisms, tumours, and enlarged glands irritating the recurrent nerves or pressing on the windpipe, and central irritation, such as is often seen in tetanus and less frequently in cerebral affections. The treatment of all these conditions has been discussed, so far as they fall within the surgeon's province, and the necessity of tracheotomy under certain circumstances pointed out. I would merely add that the patient's safety is best consulted in circumstances of doubt by resort to operation, rather than by hesitation, which may at any time involve fatal consequences.

Bronchotomy or tracheotomy.

The windpipe may be opened in three different positions, viz. between the cricoid and thyroid cartilages, above the thyroid isthmus, and below it. All three operations are often comprised under the common name Tracheotomy, which is thus used as synonymous with Bronchotomy, meaning any operation by which an artificial opening for respiration is made; otherwise the word Bronchotomy is used for all the operations on the air-passages, while the term Tracheotomy is restricted to the operation below the thyroid isthmus, that above it being called Laryngotracheotomy, and the operation through the cricothyroid interval Laryngotomy.

Laryngotomy.

Laryngotomy is the easiest of the three. Nothing is necessary except to keep in the middle line, to divide the skin pretty freely from the thyroid to the cricoid cartilage, and to cut through the cricothyroid membrane entirely from the lower border of the thyroid to the top of the cricoid cartilage, or horizontally to a sufficient extent, and then insert the tube. In urgent cases there is no need to make any preliminary incision. The knife can be plunged direct into the windpipe, and the tube may follow it at once. No vessel of importance can be injured. The little anastomotic arch formed by the cricothyroid arteries never, as far as I know, furnishes more than slight hæmorrhage, which is stopped at once by the pressure of the tube.

Laryngotomy is often required under circumstances of urgency when no tube is at hand. A pair of forceps, or in the last resort the blades of a pair of scissors, or a couple of hairpins or pieces of bent wire, will suffice to keep the wound open, and if necessary the operation can be done with a common penknife.

This operation is sufficient in all cases which involve only the vocal cords or the tissues above them. It is, therefore, practised in spasm of the glottis from all causes, including burn and scald, in erysipelatous affections spreading down the throat, and in cases of foreign body lodged in or above the glottis. Opinions differ as to the operation which is to be employed in cases of laryngitis and croup, as to which I have already expressed my own.

Laryngotracheotomy.

Laryngotracheotomy consists in making a freer incision than in laryngotomy from the lower border of the pomum Adami to about three-quarters of an inch below the cricoid cartilage, dissecting the parts till the trachea and the isthmus of the thyroid body are plainly seen, plunging the knife into the windpipe with its back to the thyroid isthmus, and cutting upwards through the two upper rings of the trachea and the cricoid cartilage.

This operation is chiefly used in childhood, when the small size of the larynx seems to forbid laryngotomy, and the depth and shortness of the neck renders tracheotomy dangerous.

Tracheotomy proper.

Tracheotomy below the thyroid isthmus requires a freer opening and a deeper dissection. The extent of the incision will, of course, be proportioned to the thickness of the neck. In a short deep neck there is no objection to

extending the incision from the cricoid cartilage to the episternal notch, but this is rarely requisite. An average incision would be from an inch and a half to two inches downwards from the cricoid cartilage. Having divided the skin and deep fascia, the sterno-thyroid muscles may be seen touching each other in the middle line, and these parts should be drawn asunder with hooks. Any vessels (arteries or veins) which bleed freely had better be tied;[1] the lower border of the thyroid isthmus will be recognised, and may be drawn up with a hook if it is unusually broad. The trachea should be dissected clean till three rings are seen fairly exposed, and should then be opened in the whole extent which is denuded, with the edge of the knife turned upwards. Then the tube is to be inserted. If the thyroid isthmus comes down unusually far it is safer to divide it in the middle line than to risk a deep dissection close to or under the sternum. In following the other course I once lost a patient from wound of a branch close to the innominate vein.

There are a few precautions which are essential to success in all these operations. The first is to keep in the middle line, and this is not always easy in cases which are operated on late at night under urgent circumstances. The head ought to be extended, as much as is possible without increasing the dyspnœa, by putting a pillow under the neck and shoulders; and the surgeon, if he has no trained assistant, must see that the head is held firmly and the body kept straight. Next it is desirable to stop the bleeding before the trachea is opened; but if the bleeding is merely venous or capillary, and from a number of imperceptible vessels, the best plan is to make the opening at once. If a gush of blood passes into the windpipe the patient must be instantly turned on his face, and it will run out again. The free admission of air into the lungs will relieve the venous congestion, and the hæmorrhage will cease. It is most important to make a free opening at first, so that the tube has ample space. I have seen the patient die while the operator was vainly endeavouring to force a tube through an opening too small for it, and thereby of course increasing the dyspnœa. There is no objection in most cases to the administration of chloroform, nor is there usually any reason for hurry in the dissection. A quiet and methodical dissection may take a minute or two longer than one where haste is the only thing thought of; but it often really saves time, as it enables the operator to insert the tube at once instead of boggling about it. As to the insertion of the tube there is not generally any difficulty if the windpipe has been opened with the requisite freedom. The old solid canula is now



Fig. 331. Fuller's bivalve tracheotomy canula. The canula is introduced with its blades closed. Then, by depressing the handles to the position marked by the dotted lines, the blades are opened, and a tubular canula is introduced between them.

[1] Mr. Hulke, in a paper in the 'Med.-Chir. Trans.' vol. lx. p. 92, gives the following practical hint from a German treatise on Tracheotomy, the reference to which he had mislaid:—

'The venous plexus overlying the trachea is enclosed between two folds of the deep fascia which pass upwards to the larynx. The veins also are much smaller above than lower down. If this fascia is fixed by pressing the nail of the left forefinger against the front of the cricoid cartilage, and a small cut be made upon this transverse to the axis of the trachea, both these folds of fascia will be divided. If now the lower lip of the cut fascia be seized with a forceps, the fascia below enclosing the veins (and isthmus of the thyroid gland if necessary) may be easily peeled down with the thin handle of the scalpel, exposing the front of the trachea by an almost bloodless dissection.'—Mr. Hulke relates a case in which he adopted this manœuvre with much success.

rarely used. Fuller's bivalve canula is the one most commonly met with; but Durham's lobster-tail director finds its way in very easily, and enables the surgeon to glide in the tube very readily. Whatever form of tube is used it should be double, for it will soon become obstructed with mucus, and the inner tube must often be withdrawn for the purpose of cleansing it. For the same reason the inner tube must project beyond the outer one, otherwise the withdrawal of the inner tube might leave the outer one obstructed.

When the double canula is securely lodged in the trachea it must be tied in with a piece of tape round the neck; and if there is any superfluous incision it may be united with one or two stitches. Several dangerous

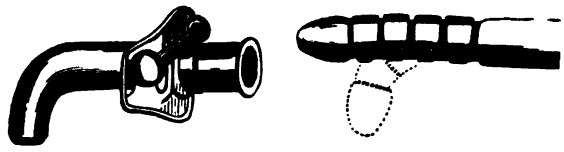


FIG. 332. Durham's canula, with 'lobster-tail' director.

complications may occur after the operation. The secretion (especially in the diphtheritic affections) will collect in the tube and must be assiduously removed by passing the feather of a pen down the inner tube, and when this no longer serves, by removing the inner tube and clearing it. It may even become necessary to remove the outer tube also and draw up the croupous membrane out of the trachea. I have seen a complete cast of the trachea and bronchi thus removed, with immense relief to the dyspnœa.

Again, the pressure of the end of the tube against the windpipe sometimes produces ulceration of the trachea, which has even been known to extend into the innominate artery, and still more frequently induces tracheitis and bronchitis. To obviate this Mr. Bryant has devised a

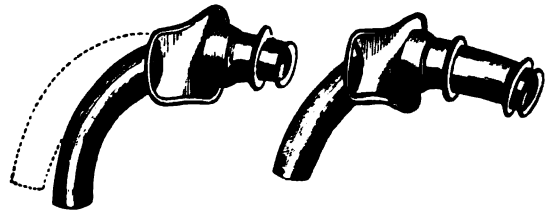


FIG. 333. Bryant's canula. The shield is movable on the neck-plate by means of a joint, and can be shortened if required.

canula in which the shield lying on the skin is jointed to the stem which rests in the trachea, in order that the tube may follow the motions of the windpipe. But the presence of the foreign body must always cause some irritation, and this seems often to be the starting-point of general tracheitis and bronchitis. In order to lessen as far as may be this irritation, and yet not to lose the security against sudden suffocation which the tube affords, the use of flexible india-rubber tracheotomy tubes has lately been advocated.[1] They are no doubt very comfortable, and when the tube has to be worn for a length of time are in my opinion very superior to the silver tubes, as they allow the patient to move his head without any distress from the impact of the end of the tube on the interior of the windpipe. Also when the silver

[1] See especially Morrant Baker, 'Med.-Chir. Trans.' vol. lx. p. 71.

tube sets up much inflammation shortly after the operation it is well to try an indiarubber one. But great care should be taken to see that the tissue of the tube is not rotten—that the tube can be bent and pulled about freely without cracking—otherwise it may easily break and leave its end in the air-tube.[1] This accident may possibly be obviated, as Mr. Baker suggests, by making the tube on a canvas lining. Another objection to the use of india-rubber tubes soon after the operation is that if the wound is at all deep it is difficult to introduce them—a difficulty, however, which disappears as the wound consolidates. I have lately used tubes made of a material which is called 'coralline,' and which is I believe a product of the manufacture of glycerine. It is solid when cold, and thus is as easy to introduce as a silver tube, but softens a little at the temperature of the body, and is far less irritating than the metal tube. It answered well in a case of phthisis laryngea which I had under observation for a long time.

In some cases when the interior of the trachea is very irritable, no tube can be tolerated. In a case of this kind, in which the patient was greatly troubled with gout, I kept the wound open quite satisfactorily for a month, by dilating it twice a day with the trivalve tracheotomy dilator.

Another frequent complication is that the fluids run down from the mouth into the larynx, and so are expelled from the wound. I have already spoken of the same distressing complication after cut-throat.

It is very desirable to restore the natural respiration as early as possible after tracheotomy, and dispense with the canula. Not only is the foreign body a constant source of irritation, but the vocal cords may get more or less consolidated together, and even in some cases the upper part of the larynx nearly obliterated. A canula should be inserted having an opening in its convexity looking towards the glottis, through which the air can pass in expiration, and a valve applied to its mouth, so that the air can be drawn inwards in inspiration, but the valve then shuts. If it is found that this cannot be borne, and that the glottis seems obstructed, the patient should be narcotised and a bougie passed through the glottis, to break down the adhesions.

[1] As happened to Mr. Howse's patient, 'Med.-Chir. Trans.' vol. lx. p. 93.

CHAPTER XXXV.

DISEASES AND INJURIES OF THE EYE. BY R. B. CARTER, OPHTHALMIC SURGEON TO ST. GEORGE'S HOSPITAL.

General consideration.

THE great importance of the eyes as the instruments of the visual function, their accessibility to many kinds of examination, and the transparency of many of the structures of which they are composed, have combined to invest their diseases with much attractiveness, and to render them objects of specially careful and painstaking research. The benefits hence arising are attended by the disadvantage that it is scarcely possible, in the space which can be devoted to the subject in this work, to present anything more than a sketch in the barest outline of the present state of Ophthalmic Surgery; and by the still greater disadvantage that surgical students are apt to look upon the subject as one which is especially recondite or difficult, and hence, doubting whether they will have time to master it, to turn away from it without even that moderate degree of attention which is necessary in order to enable them to deal skilfully with the common forms of eye-disease which constantly present themselves in practice. Than this there can be no greater error, for these common forms are as a rule extremely easy of recognition, and are highly amenable to well-directed treatment.

Accessibility of the organ.

Perhaps the first consideration which should be impressed upon the mind of the student is the importance of utilising to the utmost extent the accessibility and the transparency of the eye, in such a manner that he may become acquainted with all the facts of every case which is brought under his notice. Errors of diagnosis in the ordinary forms of eye-disease are scarcely possible to anyone who habitually practises careful scrutiny of the affected tissues; and in this, even more than in any other branch of surgery, haste and carelessness are the most frequent sources of mistake. A general observance of the cardinal rule never to prescribe for an inflamed eye without making sure that no foreign body is either embedded in the cornea or lodged beneath the lids, without looking to see whether either the cornea or the iris is implicated in the inflammation, and without determining the presence or absence of heightened tension of the globe, would do much to withdraw ophthalmic diseases from the domain of specialists, and to restore ophthalmic surgery to the general body of the art.

Superficial examination.

The first glance at a patient will often suffice to show to an ordinarily careful observer in what direction disease of the eyes is to be looked for. Sometimes there will be manifest coarse external changes, such as swelling and redness of the lids, with or without exudation at their margins; sometimes there will be manifest congestion of the ocular surface, with or without discharge, and with or without loss of the natural polish and brightness of the cornea; sometimes there will be evidence of failing vision in the gait, the aspect, and the manner of approach; sometimes, in the absence of all the foregoing conditions, there will be complaint of speedy fatigue or dimness of sight when the eyes are employed upon near objects. Any clue which may be thus afforded must, of course, be taken as a guide to further inquiry,

but must not be accepted, without complete examination, as containing or expressing the whole truth of the case. For instance, it is not very uncommon in hospital practice to see patients who have been energetically treated for an inflamed eye by leeches and local applications, but in whom the presence of a foreign body under the lid, or even embedded in the cornea, has been overlooked by some one who was more ready to prescribe than to practise careful scrutiny.

The eyelids.

It is most convenient to consider the diseases of the eye in an anatomical order; and the eyelids first present themselves for examination. Being covered externally by the common integument, they are exposed to all the morbid changes to which it is prone, and may be the seats of inflammation, of ulcer, of eruptions, of nævi and other growths, all of which conditions pass into the domain of general surgery. Regarded only as appendages of the eye, they are liable to tumours caused by obstruction of the ducts of the Meibomian glands, to distortions of shape caused by the shrinking of inflammatory effusions, to alterations of position caused by excessive or perverted muscular action, and to chronic inflammation of the follicles of the hairs which fringe their margins. They are also liable to marginal boils, which do not differ in any essential respect from boils elsewhere, but which are called 'styes,' and require especial consideration, on account of their tendency to destroy the eyelashes.

Tarsal tumours.

When the duct of a Meibomian gland is obstructed at its orifice the duct itself becomes visible through the inner portion of the tarsal cartilage as a white line, which is sometimes sufficiently prominent to produce mechanical irritation of the eye. This condition is most common in gouty people, in whom the retained secretion is often rendered still more irritating by becoming the seat of chalky deposit. In such cases the margins of the lids may be soaked with a warm alkaline lotion, containing perhaps ten grains of bicarbonate of soda to an ounce of water, in the hope of dissolving the accumulated secretion at the orifice, so that the rest may be forced out by pressure along the inner surface of the lid. If this method does not succeed, the white line may be split with the point of a sharp lancet, and the little cylinder of fatty or chalky matter turned out of its bed and removed. When the obstruction is in the channel of a duct, above its orifice, the ordinary result is the formation of a small hemispherical tumour, fixed in the tarsal cartilage, and projecting externally. The skin is freely movable over such a tumour, and is unchanged in appearance; but when the lid is everted the base of the tumour appears as a thinned and discoloured spot on the cartilage. If left alone the tumour will eventually suppurate, and will in most cases discharge itself through the cartilage and conjunctiva rather than through the skin, in the former case leaving a button of granulation projecting from the orifice by which the pus has escaped. This button may for a time be a source of irritation, but it will eventually disappear. The tumours are harmless, but inconvenient and unsightly, and they may be got rid of by a simple incision through the thinned cartilage. If this gives exit to pus nothing more need be done; but if suppuration has not occurred the tumour will contain semi-transparent gelatinous matter, and is then lined by a secreting membrane. In such case the contents should be emptied out by means of a small scoop with sharp cutting edges, which may then be used to scrape away the lining membrane of the cavity, so as to destroy the secreting surface. When this is done the cavity will fill with blood, and

Their treatment.

then, in the course of a few weeks, the swelling will dwindle and disappear. Should it fail to do so it may be punctured again, and its lining membrane removed more effectually than before. A patient who has once had such a tumour will be liable to others, because as in the case of sebaceous cysts, there seems to be a special proclivity on the part of some persons to obstruction of the ducts or orifices of glands.

Blepharitis.

The inflammation of the hair-bearing margins of the eyelids, which has been called ophthalmia tarsi, tinea tarsi, blepharitis, and by other names, is almost confined to the children of the poor, and seems to be due either to the direct influence of dirt and atmospheric irritants, or to contagion. The seat of the disease is in the follicles of the eyelashes, and it is essentially an ulcerative inflammation affecting the lining of these follicles. It usually commences in the upper lid, near its middle portion, and first shows itself by the formation of a scab or crust, which cements together the bases of three or four of the cilia. The margin of the lid, at the point corresponding to the scab, is somewhat swollen, and the swelling extends a line or a line and a half upwards. The skin covering the swelling is seldom reddened, but is usually smooth and glossy from tension. The size of the swelling is about equal to that of the scab, and the whole matter looks very unimportant. If the scab is softened and removed, it may be seen with a magnifying glass that the orifices of the hair-follicles are patulous, and that they yield a small quantity of thin discharge. This, mingling with the secretions of the adjacent Meibomian and sebaceous glands, dries into the crust which is characteristic of the malady. The inflammation appears to commence near the orifice of each follicle, and gradually to spread to its deeper parts, killing and loosening the eyelashes as it proceeds. The secretion is either contagious or is at least actively irritating, so that the disease spreads along the margin of the lid from its original centre, and appears before long in the lower lid also. After a time the swelling of the lid-margin removes the lower lachrymal punctum from contact with the eyeball, so that the tears are no longer carried into the nose, but lodge and overflow and become additional sources of irritation, often giving rise to inflammation of the conjunctiva, and to the development of blood-vessels beneath the corneal epithelium. The effusion which forms the marginal swelling of the lids undergoes gradual contraction, which curves and everts the tarsal cartilages, while the persistent follicular inflammation destroys the eyelashes, or leaves them weak, scanty, distorted, and useless. The edges of the lids become bare, red, everted, and unsightly, the tears overflow the cheeks, the conjunctiva is highly vascular, and the cornea is clouded by active inflammation or residual opacity. Such are the results of neglected blepharitis.

Its treatment.

In its early stages the malady yields rapidly to treatment. It is then only necessary to remove the crusts by soaking them with a warm alkaline lotion, and to apply an astringent to the inflamed surface beneath. A good lotion is made by dissolving five grains of bicarbonate of soda in an ounce of hot water; and the best astringent for home use is an ointment of the precipitated yellow oxide of mercury, which may be thrown down by any alkali from a solution of the perchloride. This ointment is commonly known as Pagenstecher's, and has many uses in ophthalmic surgery. For blepharitis it should contain about twenty grains of the oxide to an ounce of vaseline. It is necessary to remove the crusts and apply the ointment once a day, and to persevere with this plan for some little time after recovery is apparently complete. If the application is too soon abandoned the disease will again

creep out of the follicles, and speedy relapse will occur. In cases which resist treatment the surgeon should himself remove the crusts, and should pencil the exposed surface with a fine point of nitrate of silver, diluted by having been fused with an equal weight of nitrate of potash, and then run into a mould for use. In the chronic cases, in which structural mischief has already been produced, in which the eyelashes are destroyed and the lids everted, little more can be done than to slit up the lower lachrymal canaliculus as far as the caruncle, so as to facilitate the escape of tears, and thus to diminish the discomfort of the patient.

Styes.

The little marginal boils which are called styes do not differ in any essential respect from boils in other parts of the body, and, like them, they generally indicate some derangement of health to which attention should be paid. They run an ordinary course in a brief period of time, and would be of little importance were it not for their tendency to destroy the hair-follicles, and thus to occasion unsightly gaps in the row of eyelashes. On this account, while an endeavour is made to prevent their recurrence by constitutional treatment, it is desirable to check the development of each individual boil, which may be done, if it is seen sufficiently early, by pulling out an eyelash from the centre of the little pimple, and then touching it with a fine point of nitrate of silver. If suppuration cannot be prevented a poultice and an early incision will be desirable; and, if there is no special indication for constitutional treatment, the administration of the tincture of perchloride of iron will often prove advantageous.

Malposition of eyelashes.

Perverted growth or direction of the eyelashes, by which they are brought into contact with the eyeball, and become sources of irritation and even of ulceration, is met with under three different conditions: first, as a result of hypertrophy or redundancy of growth; secondly, as a result of incurvation of the upper lid by the contraction of inflammatory products in the conjunctiva; thirdly, as a result of displacement of the lower lid by muscular spasm. The first variety is most commonly a remote consequence of a slight degree of blepharitis; the second is a remote consequence of the more severe forms of conjunctivitis; the third occurs chiefly in elderly persons, and occasionally follows operations upon the eye.

Redundancy of eyelashes.

Redundancy of growth of cilia is usually met with only on some small portions of the margin of the upper lid, and generally near the outer canthus. The superfluous hairs may be plucked out from time to time with forceps; and if this is done frequently, the follicles from which they spring will sometimes undergo atrophy. In other cases epilation will tend to the production of a more active growth; and then the portion of cartilage containing the follicles may be excised without sacrifice of skin, or the follicles may be destroyed by including them in a thread of silk inserted after the manner of a seton, and left until it produces suppuration.

Incurvation of cartilage.

When the upper lid is incurved the best method of treatment is to split the tarsal cartilage into an anterior and a posterior layer, by the careful use of a thin and keen scalpel. The middle portion of the anterior layer may then be excised in a horizontal direction, including skin and orbicularis muscle, and the lower strip, carrying the eyelashes, may be transplanted upwards and secured by sutures, leaving the lower margin of the posterior layer exposed. No dressing but the dried blood is required, and the disfigurement of the lid which is at first produced will be recovered from in the course of a few weeks, leaving the lashes permanently removed from the eye.

Inversion of cartilage.

The inversion of the lower lid by muscular action may sometimes be overcome by the application of sticking-

plaster or of contractile collodion, but will more frequently require the excision of a strip of skin and muscle, which should be very narrow, and should be taken from immediately below the tarsal margin. When inversion follows an operation upon the eye, excision of skin should, in most cases, be performed without delay, as otherwise the mechanical irritation of the displaced lashes may produce disastrous consequences. The good result of the operation depends chiefly on the removal of the marginal portion of the orbicularis; and, if too much skin is taken, absolute eversion of the lid may be the result.

Ectropium.

Eversion of the lid (commonly called ectropium) may be produced by the contraction of inflammatory exudations external to the cartilage, by the contraction of cicatrices on the face, by redundancy or hypertrophy of the conjunctiva, by the mere weight of the lid in cases of paralysis of the portio dura, and also, sometimes, in aged people in whom there is no paralysis, but in whom the orbicularis is very feeble and the skin loose and relaxed. In the treatment of wounds about the face the probable action of cicatrices on the lids must be considered, and contractions must as far as possible be prevented by skin-grafting, and by careful attention during the healing process. When the cicatrix has assumed its permanent condition any ectropium which has been produced may often be remedied by a well-planned plastic operation. The treatment of paralytic ectropium resolves itself into that of the paralysis, which may sometimes be amenable to the judicious application of a continuous or an induced galvanic current; and the form which is due to conjunctival hypertrophy, or to mere senile relaxation of parts, may sometimes be cured by the contraction of a conjunctival eschar, made by the free application of solid nitrate of silver. Failing this the redundant conjunctiva may be excised, and the lid brought into position by sutures. Ectropium should always be remedied if possible, for it is not only a conspicuous and unsightly deformity, which entails much inconvenience by interfering with the natural course of the tears, but it also exposes the eye to injury from the absence of its natural protectors.

Wounds of eyelids.

Wounds or injuries of the eyelids, of whatever nature, should be treated on the principle of preserving every fragment of skin, and of endeavouring to avoid distortion of shape. Cuts or lacerations should be carefully cleansed from dirt and coagula, their edges accurately united by a sufficient number of fine sutures, and then covered by a crust of styptic colloid, or of dried blood and tincture of benzoin, beneath which primary union will often take place under the most unpromising circumstances, thanks to the vitality and vascularity of the parts concerned. The best material for eyelid sutures, especially for complicated or irregularly lacerated wounds, for which many are required, is the finest platinum wire, as fine as human hair; and it may be conveniently inserted by the needles which are made for threading the smallest beads. When wire is not at hand human hair makes a good substitute, except that its elasticity exposes it to slip when it is being tied.

Ptosis.

The condition known as ptosis, in which the upper lid is partially or entirely closed, may be a result of injury, or of paralysis of the levator palpebræ muscle. I have seen one instance in which complete ptosis was produced by accident. The patient, a lad of ten years old, fell down in such a manner that a small batswing gas-burner caught beneath his upper lid, and the weight of his body tore the tarsal cartilage from its attachment to the tendon. Some months after the injury I made an incision along the upper lid, sought for and recovered the muscle, and reunited it to the car-

tilage by three catgut sutures. The result was entirely successful, only very slight drooping of the lid remaining. When ptosis is caused by paralysis it is often recovered from under the influence of treatment addressed to the nervous affection on which the paralysis depends: but, failing this, an operation may be required in order to reopen the eye, and to enable it to take part in vision. The most successful plan is to make a single horizontal incision along the middle of the fallen lid, to detach the skin upwards and downwards, to excise a broad strip of the orbicularis muscle, and to unite the edges of the muscular gap by catgut sutures without any sacrifice of skin. In this way the lid may be effectually lifted, without producing the appearance of dragging or straining which follows the removal of skin, and also, if the operation is nicely managed, without tilting forward the lower margin of the cartilage.

Diseases of the conjunctiva.

Next in order to the diseases of the eyelids come those of the conjunctiva, which, after lining the lids, is reflected to cover the surface of the eyeball, and is continued over the cornea by its epithelial layer, although its other elements are firmly united to the sclerotic at the corneal margin. The conjunctiva, as a mucous membrane, is liable to inflammation attended by increased secretion, which may assume a purulent character, and may become actively contagious. It is also, as the external covering of the eye, exposed to irritation by atmospheric dirt or noxious vapours, or by the lodgment of foreign bodies upon its surface.

Inflammation of the conjunctiva.

Inflammation of the conjunctiva is commonly divided into the simple or catarrhal, and the purulent; and, although these two forms pass into one another by imperceptible gradations, the distinction is not without practical convenience. In simple conjunctivitis the membrane is congested and somewhat tumid, and its secretion, which is of a mucous character, readily dries into crusts upon the eyelashes and the margins of the lids. The caruncle and plica semilunaris are somewhat swollen, there is a certain amount of itching or smarting, and the lids become adherent during sleep from the drying of the viscid secretion. There is also some increase in the flow of tears, but there is no tensive or deep-seated pain, no impairment of vision, except momentarily from the presence of secretion which can be cleansed away, no turbidity of the cornea or diminution of the lustre of the iris, no irregularity or sluggishness of the pupil, and the congestion is limited to the conjunctiva, and neither extends to the cornea nor to the fine zone of sclerotic vessels which surrounds the corneal margin. The latter point may readily be determined by finger-pressure through the medium of the lower lid, which should be first pushed up so as partially to cover the cornea, and then made to glide downwards over the ocular surface. The pressure will empty the conjunctival vessels for a moment, and will leave a pure white track right up to the corneal margin. This track will be instantly effaced by the returning blood; but its perfect whiteness in the neighbourhood of the cornea is the point to be observed, and shows the absence of any tendency to iritis. In order to see that there is no encroachment of vessels upon the cornea, it is best to examine the margin with a magnifying lens.

Simple or catarrhal.

Simple conjunctivitis, in the mild form which has been described, is a trivial affection, curable in a short time by the local employment of any metallic astringent, and which yields most readily to the frequent use of a comparatively mild application. A solution of nitrate of silver, of about two grains to the ounce of distilled water, is perhaps the most efficacious; but its tendency to stain handkerchiefs is an objection to its use, and

a solution of sulphate or chloride of zinc, or of sulphate of copper, will usually fulfil every indication. The lower lid should be drawn down, and a little of the lotion should be applied to its inner surface, by means of a goosequill scoop. A solution of acetate of lead would be equally beneficial, but the application of a salt of lead to the eye is attended by the objection that, if there should be any loss of corneal epithelium, an opaque white deposit of carbonate of lead may be left upon the abraded surface. The lotion which has been beneficial in one case is sometimes preserved by a patient, to be used again under very different circumstances; and hence an application containing lead should only be ordered with great circumspection.

Several varieties.

When conjunctivitis passes beyond this simple form, and produces purulent discharge and swelling of the conjunctiva and eyelids, it often becomes a very formidable affection, which not unfrequently leads to blindness by interfering with the nutrition of the cornea and producing sloughing or necrosis of that membrane. Purulent conjunctivitis may occur as a sporadic affection, but its chief forms are three in number, the infantile, the gonorrhœal, and the epidemic.

Infantile purulent ophthalmia.

The first of these, infantile purulent ophthalmia, commences about the third day after birth, and is, in most cases, probably due to inoculation with the vaginal secretions of the mother. The inflammation rapidly gains in intensity, the conjunctiva lining the eyelids becomes greatly swollen, the lids are puffy and red externally, and a profuse discharge of thick pus is poured out. The conjunctiva covering the globe is always much congested; and in the worst cases it is elevated by swelling, and overlaps the corneal margin, producing the condition called chemosis. When this occurs the cornea, which derives much of its nourishment from the conjunctival vessels, is placed in great danger. It soon becomes turbid, and the turbidity may soon pass into necrosis. In neglected cases the pus dries upon the palpebral margins and cements them together, so as to retain the fresh secretion in the conjunctival sac, where it distends the lids and presses injuriously upon the eye. The severity of the affection varies much in different cases, and may be measured by the swelling of the lids, and by the viscidity of the discharge. It probably depends in some measure upon the character of the vaginal secretion, and also upon the strength and vital resistance of the infant; and on both grounds the worst cases are met with in the subjects of inherited syphilis. When the inflammation is violent or the infant diseased or weakly, sloughing of the cornea may take place very rapidly; but when the inflammation is moderate, the infant vigorous, and the discharge thin and as if muco-purulent, the disease may even wear itself out harmlessly. Under almost all circumstances, if the cornea is bright and clear when first seen by the surgeon, a favourable prognosis may be confidently given. If the cornea is turbid the prognosis must be very guarded; and, if it is concealed by the swelling of the lids, no opinion must be hazarded until it can be seen.

Treatment of infantile purulent ophthalmia.

As long as the cornea retains its integrity the treatment required is cleanliness, and the regular application of an astringent; and if properly carried out it is not too much to say that this treatment will be invariably successful. The lids being separated by the fingers, a small stream of warm water may be allowed to trickle gently between them from a sponge being received at the side of the face in a basin, until all discharge is washed away. The lids must be gently pressed with a soft absorbent handkerchief, to remove water from the conjunctival sac, and then a few drops of a

solution of nitrate of silver, of the strength of two grains to the ounce of distilled water, must be suffered to fall between them. Lastly, the margin of the lids should be effectually anointed with vaseline, to prevent their adhesion from the drying of the discharge; and the whole proceeding must be repeated every four hours. In a very short time manifest improvement will take place; and the applications may be made less frequently, but they must not be entirely discontinued until the cure is complete.

Mercurial inunction.

If the infant is the subject of inherited syphilis mercurial inunction should be practised. For this the best method is to spread half a drachm of blue ointment on a strip of flannel, and to button it round the abdomen, renewing the ointment, on the same piece of flannel, every day. If the infant is feeble it may take half a drachm of cod-liver oil, with a drop of liquor cinchonæ, twice a day; and if the mother's milk is deficient in quantity or quality, a wet-nurse should be procured, or careful hand-feeding should be had recourse to. It is seldom enough for the surgeon to be content with verbal instructions, but he must show the nurse how the nitrate of silver lotion is to be applied, and must carefully supervise the arrangements for the feeding.

Implication of cornea.

When the cornea is already turbid the same kind of treatment must be pursued, and if sloughing does not occur the turbidity will in most cases clear away in the course of time, if not entirely, yet sufficiently to leave useful vision. If only a small portion of the cornea should perish, recovery may still take place, leaving the curvature of the membrane altered and flattened, the iris adherent to the cicatrix, and the pupil more or less closed or displaced. When the corneal slough is extensive the result is the condition called complete staphyloma, in which the iris becomes blended with the cicatrix, and projects as a bluish-white prominence in the situation of the cornea. In such cases perception of light is often preserved, but never vision of objects; and the subjects of this misfortune form a very large proportion of the inmates of our blind asylums and similar institutions. It should never be forgotten, especially by those who are engaged in obstetric practice, that corneal staphyloma would probably never occur, as a result of infantile purulent ophthalmia, if that malady were always promptly and properly treated. The medical attendant of a lying-in woman should leave orders that he must be summoned without delay if any inflammation of the infant's eyes should be perceived.

Gonorrhœal ophthalmia.

Gonorrhœal ophthalmia, in its symptoms, course, and termination, greatly resembles the infantile variety. As its name implies, it occurs only in adults, or at least only in those who have been in contact with the secretion of gonorrhœa. It is generally believed to be the result of direct inoculation with the urethral discharge, and is doubtless often produced in this way. It is thought by some to be occasionally part of the original disease independently of inoculation, and I have seen a few cases which rather tend to this conclusion, although inoculation would be very difficult to disprove. In the treatment of gonorrhœa, more especially of a first attack, it is always desirable to caution the patient about his eyes, so that he may neither rub them with fingers soiled with urethral discharge nor in any other way suffer it to be brought into contact with the conjunctiva. It is an important difference between infantile and gonorrhœal ophthalmia that the latter, either from the essential nature of the affection, or from the different character of the mucous membrane in the adult, is much less amenable to treatment than the former, so that a very guarded prognosis should be given in every case. In

old times the treatment of gonorrhœal ophthalmia was of the most heroic description, including bleeding from the arm, the application of many leeches to the temples, the administration of purgatives and mercury, and the enforcement of an antiphlogistic regimen. Under this method the cornea usually sloughed; and the credit of introducing a more rational system is due to Mr. Dixon, who perceived that sloughing was the danger chiefly to be guarded against, and that one way of guarding against it was by stimulants and a generous diet. Von Graefe carefully studied the question of local medication, and laid down rules for the application of nitrate of silver, which, if they are strictly observed, will conduct many cases to a successful termination.

Protection of sound eye.

The first principle of treatment, when only one eye is affected, is to protect the other from inoculation. For this purpose the sound eye should be covered with a piece of waterproof tissue, gummed to the skin by collodion, and over this a compress and bandage should be applied. A still better protection has lately been introduced, which consists of a watch-glass inserted into a piece of waterproof tissue, spread with adhesive plaster.

Local treatment.

The sound eye being covered, the surgeon takes a solution of nitrate of silver, of about a scruple to the ounce, or still better, a solid stick of a compound made by fusing together one part of nitrate of silver and three parts of nitrate of potash. The eyelids being everted and cleansed from discharge, their inner surfaces are carefully painted over with the solution, or touched in every part with the stick; and then, after a few moments, before they are released, the superfluous nitrate of silver is decomposed by a brushful of a solution of common salt, which, in its turn, is washed away with water. The nitrate of silver should be so applied as to produce only a superficial eschar, extending no deeper than the epithelium, and sparing the basement membrane, and it should not be suffered to come into contact with the cornea. The application should be renewed as often as the superficial eschar is cast off, which will generally be about every eight hours. It will occasion acute pain, and hence, more especially in bad cases, in which the lids are brawny, much swollen, difficult to evert, and slippery from discharge when they are everted, it is often desirable to administer an anæsthetic, and to hold the margin of the upper lid with toothed forceps. In the intervals between successive cauterisations, unless the patient is sleeping, the conjunctival sac should be frequently and gently syringed out—perhaps every hour—with a weak solution of chloride of zinc, of one or two grains to the ounce; and, as the local symptoms abate, the nitrate of silver may be laid aside and the strength of the zinc lotion increased. Mr. Bader has recently contrived a glass syringe, with a broad flat nozzle, by means of which soft ointment may be easily deposited in the conjunctival sac; and, when this is used, as the remedies will remain for a longer time in contact with the inflamed membrane, they may be of a less potent character. Vaseline is the best vehicle for them; and Mr. Bader strongly recommends an ointment of iodoform, which I have also used with good results at St. George's Hospital. The strength may be twenty grains to the ounce, and half a drachm or so may be pressed out under the upper lid. An ointment containing from five to ten grains of nitrate of silver to the ounce may be used in the same manner. Furthermore, as an accessory to more active treatment, a solution of eserine sulphate (gr. iv to ʒj) of distilled water should be dropped into the eye from time to time, on account of its power to check inflammatory processes by arresting the migration of white corpuscles.

While such is the local treatment as far as the eye is concerned, the con-

stitutional state and the urethritis should also receive attention. For the latter it is best to use very weak astringent injections, and to abandon any internal remedies, such as copaiba, which might interfere with appetite or digestion. The diet should be nourishing but unstimulating, and means should be taken to allay pain and to procure sleep. As already stated, the chief risk attendant upon the ophthalmia is that of sloughing of the cornea, which is produced partly by the mechanical arrest of its blood-supply, and partly also, in all probability, by the depressed state of the general bodily nutrition, or even, in some cases, by the septic influence of the gonorrhœa itself. In order to obviate the effects of these conditions, the administration of quinine, in doses of two or three grains three times a day, will generally be desirable.

General treatment.

When the swelling of the ocular part of the conjunctiva is very thick and firm, the cornea will be exposed to additional danger, and in such cases it is desirable to divide the swollen tissues freely, by three or four incisions radiating from the corneal margin, and carried well down to the sclerotic. Such incisions may be conveniently made with scissors, which do not expose the sclerotic itself to any danger of being divided.

Scarification.



FIG. 334.

When sloughing of the cornea occurs it will sometimes be universal, destroying the whole of the membrane, and leading to collapse and wasting of the globe, or to the formation of a complete staphyloma, in either case with total loss of sight. More frequently it is but partial as regards its superficial extent, but it usually goes on to perforation, after which improvement commences, and the resulting ulcer heals, leaving an opaque cicatrix, to which some portion of the iris, and more or less of the pupillary margin, are firmly and inseparably adherent. When this happens vision will be more or less impaired, according to the position of the cicatrix, to the degree of flattening of the cornea which has been produced by its contraction, and to the extent of the incarceration of the pupil; and the flattening of the cornea often seriously limits the improvement of sight which may be gained by placing an artificial pupil behind some still transparent part. It is, therefore, highly important to prevent perforation of the cornea, and this may often be done by paracentesis of the anterior chamber at the corneal margin, the artificial evacuation of the aqueous humour having a tendency to prevent the extension of the sloughing process, and arresting it, as spontaneous perforation arrests it, probably by diminishing the pressure from within. Paracentesis of the anterior chamber should be performed at the corneal margin on the outer side, by a puncture from any sharp instrument, and by the subsequent insertion of a blunt probe, so as to press back the posterior lip of the little wound, to allow the aqueous humour to escape. It is most safely performed by the aid of the special needle made for the purpose, and shown in Fig. 334. This needle has a stop or shoulder to arrest its penetration, so that it can wound neither the iris nor the lens; and a probe for opening the puncture is mounted on the same handle. It is best to have the patient recumbent, and the operator, standing behind his head, should raise the upper lid and lock it under the orbital margin with two fingers,

Sloughing of cornea.

Paracentesis of anterior chamber.

of liquor chlori, as a step towards astringents of a more active character; and this remedy appears to have the incidental advantage of destroying the infective quality of the secretion. It should be dropped into the eyes twice daily, and the results of its employment should be watched with the greatest care. If the conjunctival swelling shows a tendency to become more dense, or if there are symptoms threatening the spreading of inflammation to the cornea, then the liquor chlori must be laid aside in favour of atropine and soothing fomentations. If, on the contrary, the conjunctival swelling becomes more lax and voluminous, and the secretion more abundant, then the liquor chlori should be superseded by the diluted solid nitrate of silver, applied as directed for the gonorrhœal form of the affection; and this in its turn, as the condition of the patient improves, should be superseded by solutions of the salts of copper or zinc.

Recapitulation of general principles.

Bearing in mind, then, that it is impossible to draw any line of demarcation between the mildest form of conjunctivitis and the most severe purulent ophthalmia, and that the successful treatment of each case will depend upon a correct appreciation of its stage and its tendencies, and upon accurate observation of the effects of the first remedies selected, it may be laid down as a general principle that all mild forms will bear metallic astringents from the beginning, and will often be readily cured by them. The more severe forms display an early period of acute irritation, in which any stimulation would be mischievous, and would increase the severity of the attack. This period must be tided over by the local use of atropine and hot fomentations, aided by such regimen and general treatment as the state of the health may require. It may lead either to a brawny swelling of the conjunctiva, with thin discharge and a tendency to corneal death or inflammation, or to a voluminous and lax swelling, with discharge of a purulent character. The former condition, when of a pronounced kind, forbids the use of local stimulation; the latter requires the repeated destruction of the epithelium by caustic.

Treatment of corneal complications.

When the cornea becomes ulcerated, if the ulcers threaten to perforate, the treatment by paracentesis must be had recourse to. Ulcers which do not threaten to perforate require at first no modification of the plans already mentioned; but as soon as a process of repair commences it may be promoted by various local applications, which need not interfere with those required by the conjunctiva. Among these the first place may be given to Pagenstecher's yellow oxide of mercury ointment, or to dry calomel sprinkled over the cornea in small quantity; or Dr. Williams's citrine ointment may be tried (in which olive oil is replaced by cod-liver oil), or one containing a little red oxide of mercury or a little sulphuret of arsenic.

Papillary granulations.

Whatever may be the fate of the cornea, the subsidence of the acute stage of the disease may lead either to perfect recovery or to a state of chronic inflammation of the conjunctiva, in which there is great liability to frequent relapses, and a tendency to hyperplasia, which shows itself in an exuberant crop of secondary granulations in the palpebral folds and on the lining of the lids. These granulations differ from the follicular or sago-grain granulations both in appearance and in nature; and they are a result of hypertrophy of the conjunctival papillæ, which are strictly analogous to those of the derma. The eyelids become villous over their whole internal aspect, and the palpebral folds may be almost shaggy with enlarged and vascular papillæ. In process of time the tendency to relapse dies out, but the papillæ remain, and may assume a warty appearance while the subconjunctival tissue becomes

Lapis divinus.

Treatment of the epidemic conjunctivitis.



which should also rest against the inner side of the eyeball to check rotation inwards. The point of the needle should then be thrust through into the anterior chamber at the spot indicated; and, in most cases, the puncture should be re-opened, either with the needle or with the probe, twice daily until healing of the ulcer has commenced.

Flattening of cornea.

Whenever there is considerable loss of corneal substance, even although there may be no perforation, a certain amount of flattening of the cornea must be expected; and whenever perforation has taken place the cicatrix will be likely to become prominent under the influence of the pressure from within which is produced by the action of the recti muscles. In order to obviate this tendency the eye should be supported, during the whole period of healing of an ulcer which has perforated, by the careful application of a pad of carded cotton-wool, retained by a compressive bandage; and, in some cases, iridectomy may be performed at a point opposite to the ulceration. The effect of this will be still further to diminish a tendency to projection, and also to provide an artificial pupil in a position where the cornea is likely to remain transparent.

The purulent ophthalmia of infancy, and the purulent ophthalmia of gonorrhœa, are alike highly contagious, and would be communicated in their most virulent forms by any conveyance of their discharges to the conjunctiva of a healthy eye. But as a matter of fact, on account of the precautions taken with regard to them, they are seldom propagated in this way; and the term contagious ophthalmia is used almost exclusively to denote an epidemic form of conjunctivitis which is said to have prevailed in Egypt from time immemorial, and to have been introduced into Europe by the French army in the beginning of this century, Epidemic conjunctivitis may assume every degree of severity, from the most trivial catarrhal form, which is curable by an astringent lotion in a few hours, to the most severe and destructive suppurative inflammation. In hospital practice it is very common to see conjunctivitis of no great severity run through a family, or even to see it prevail in a particular street or group of buildings; and the tendency to pus-formation will usually be much more marked in some patients than in others. When the malady appears in large communities, living under insanitary conditions, it usually spreads with great rapidity, and assumes a highly dangerous character. The most remarkable examples of this tendency have been furnished by regiments and by large schools, more especially schools for pauper children. Both in regiments and in schools it has been found that circumstances prejudicial to health, such as over-crowding, imperfect ventilation, want of cleanliness, and improper feeding, have a tendency to produce the development in the conjunctiva of bodies which are known as 'sago-grains,' or follicular granulations; and that the presence of these granulations involves a peculiar vulnerability to the causes by which contagious ophthalmia is produced. The granulations themselves are chiefly found about the reflection of the conjunctiva from the outer part of the lower lid to the surface of the eyeball; and they appear as small, rounded, pellucid prominences. In their essential nature they are analogous to enlarged glands, and they consist of aggregations of lymph-cells, the connective tissue between which has undergone absorption or displacement. Sporadic cases of follicular granulations are frequently met with even among people of good surroundings, and the granulations may shrink and disappear without producing ophthalmia. But they are, nevertheless, a delicate test of the sanitary state of a community; and, when contagious ophthalmia appears in

Epidemic ophthalmia.

Follicular or 'sago-grain' granulations.

a school or regiment, all eyes should be examined for granulations, and all in which they are present should at once be taken under treatment. For the granulations themselves it is only necessary to touch the conjunctiva at intervals with some stimulating application; and there is probably none better than the so-called *lapis divinus*, a mixture of equal parts of sulphate of copper, nitrate of potash, and alum, fused together and run into a mould. The resulting stick may be heated at one end over a gas-flame, and its fused external parts wiped away, until it is shaped to a smooth and tapering point, which can be applied conveniently to all the wrinkles of the conjunctival membrane. The lapis occasions some smarting, especially at the first few applications; but this may be diminished by holding down the lid until the effect has exhausted itself upon the palpebral conjunctiva, and also by bathing with cold water immediately afterwards. It is sufficient to make the application once daily; and, as the granulations diminish in size, the intervals may be increased. In the course of a few weeks, in favourable cases, the enlargements will be absorbed and will disappear.

Lapis divinus.

In the treatment of the conjunctivitis itself, whether or not it has been preceded by the presence of granulations, the practitioner must be mainly guided by the severity of the affection, by the amount and density of the swelling of the ocular conjunctiva, and by the presence or absence of turbidity or irregularity of the corneal epithelium, or of a tendency to the passage of vessels from the conjunctiva to the cornea. It is first of all necessary to ascertain, in every case, that the disease is not due to the presence of a foreign body, and the next point is to observe whether the inflammation shows any tendency either to spread to the cornea or to interfere with its nutrition. In very acute forms, with much swelling and profuse discharge, the ocular conjunctiva soon overlaps the cornea, as in gonorrhœal ophthalmia; and in proportion to the bulk of the resulting chemosis, and to the firmness of the effused material, it threatens the life of the cornea, and sometimes produces rapid necrosis, without antecedent inflammation. In other cases, less severe in degree, there is an early tendency to the development of a vascular keratitis, and fine twigs and loops of newly formed vessels may be seen encroaching upon the cornea, especially at its upper and lower portions. In others, again, there is a tendency to corneal ulceration of an inflammatory character, the first evidence of which is furnished by irregularity, roughness, and dulness of the epithelium at the margin. When these conditions are absent, when the swelling of the lids is not excessive, and when the corneal epithelium is bright and undisturbed, the treatment resolves itself into the employment of metallic astringents. Among these a solution of acetate of lead is perhaps the best; but, on account of the already mentioned danger of applying it to any case in which the corneal epithelium is abraded, and in which it would lead to the formation of an opaque deposit of carbonate, it is generally safer to use the sulphate of copper, or the sulphate or chloride of zinc, or the nitrate of silver; or the sulphate of copper may be applied in the form of lapis divinus. In some instances it will be found desirable to vary the astringent from time to time, care being always taken not to select one of too active a character, and to limit its operation as far as possible to the eyelids and the palpebral folds.

Treatment of the epidemic conjunctivitis.

In the more severe forms, with profuse purulent discharge and early and considerable swelling, it is found that the stronger astringents are not tolerated at the commencement of the disease, and that sedatives are first required. In such cases Von Graefe strongly recommended the application

of liquor chlori, as a step towards astringents of a more active character; and this remedy appears to have the incidental advantage of destroying the infective quality of the secretion. It should be dropped into the eyes twice daily, and the results of its employment should be watched with the greatest care. If the conjunctival swelling shows a tendency to become more dense, or if there are symptoms threatening the spreading of inflammation to the cornea, then the liquor chlori must be laid aside in favour of atropine and soothing fomentations. If, on the contrary, the conjunctival swelling becomes more lax and voluminous, and the secretion more abundant, then the liquor chlori should be superseded by the diluted solid nitrate of silver, applied as directed for the gonorrhœal form of the affection; and this in its turn, as the condition of the patient improves, should be superseded by solutions of the salts of copper or zinc.

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thickened and indurated. Such a state is apt to occasion the development of vessels beneath the corneal epithelium, and these vessels are sometimes so numerous and so closely set that they produce opacity and loss of sight. In order to prevent such an occurrence the stage of improvement from the acute attack requires to be carefully watched, and the application of nitrate of silver should be regularly made for some time after the violence of the disease is exhausted. When the nitrate is at last laid aside it must be replaced by the long-continued use of some milder application, as by a lotion containing some salt of zinc or lead or copper. The most disastrous results are often produced in cases in which granulations in the palpebral folds are neglected or suffered to escape notice, because they undergo in course of time a gradual degeneration and contraction, by which the cartilages of the upper lids become incurved, and the cilia are brought into contact with the eye. The cases of chronic trichiasis which frequent our hospitals have nearly always this history. The tarsal cartilages are shortened, thickened, and unduly convex from above downwards; and on everting the lids the conjunctiva is seen to be crossed by hard dense lines resembling cicatrices.

Treatment of contagious ophthalmia in public institutions.

When contagious ophthalmia makes its appearance in any public institution, or in any body of people living under similar conditions, the surgeon should at once recognise the gravity of the evil, and should enforce the most stringent precautions to prevent the spreading of the malady. In the first place, the patient should be entirely separated from the unaffected persons; and the latter should be examined for follicular granulations, which should be subjected to local treatment wherever they are found. The general conditions of living should be considered, with especial reference to the quantity and quality of food, the ventilation of dwelling-rooms and dormitories, and the cubic space allotted to each person. The ordinary means of communication of ophthalmia, especially by a community of washing arrangements, should be remembered and guarded against; and the treatment of the inflamed eyes should not only be conducted with the greatest care, to discriminate the special requirements of each, but should be continued until no trace of mischief is left lurking in the palpebral folds.

Diphtheritic conjunctivitis.

In every epidemic of conjunctivitis we meet with a few cases in which the discharge, instead of resembling ordinary pus, is coherent or fibrinous, so that it can be peeled off in strips from the conjunctiva, leaving a bright red surface, which is usually dotted over with bleeding points. These cases require no modification of treatment, but they are worthy of notice, because they have often, and erroneously, been termed 'diphtheritic.' The affection which has been called diphtheritic conjunctivitis is scarcely ever seen in England, but it is not uncommon in Berlin and other parts of Germany, and has been described by many German writers. The diphtheritic fibrinous effusion does not occur on the conjunctival surfaces, but in the interstices of the subconjunctival tissue. The prominent symptoms are great pain, heat, and swelling of the eyelids, with distension of the subconjunctival tissue by a pale, firm, brawny effusion, which arrests the local circulation and threatens the cornea with speedy destruction by necrosis. The prognosis is excessively unfavourable, and the treatment must be conducted on the general principles already laid down, with the addition of compresses wrung out of iced water in the early stages, to relieve the heat and pain. At a later period hot fomentations will promote vascularisation and repair of tissue, and the internal use of mercury is said often to have been beneficial.

A familiar form of inflammation of the conjunctiva is that which is asso-

Phlyctenular conjunctivitis.

ciated with the course of the little pimples known as 'phlyctenulæ.' Phlyctenulæ appear to resemble follicular granulations, in that they are essentially abnormal aggregations of lymph-cells, but they are seated on the ocular instead of the palpebral conjunctiva, and they undergo inflammation and ulceration. Each phlyctenula runs its course in about eight days. The elevation throws out fluid at its summit and becomes a vesicle, which bursts and forms a small ulcer, the centre of which is covered by a tenacious film of buff-coloured material. This undergoes disintegration and is cast off, and then the ulcer heals. The phlyctenulæ may be either single or multiple, and they often appear in successive crops. The formation of each vesicle is attended by some burning or stinging pain, which subsides when rupture has occurred, and is succeeded only by such sensations of itching or discomfort as may be due to the amount of attendant conjunctivitis. Phlyctenulæ may appear on the cornea, but their most common seat is in the ocular conjunctiva, just beyond the corneal margin. A single one hardly requires any other treatment than rest of the affected eye and the application of a weak astringent lotion; but recurrent phlyctenulæ point to disorder of the general nutrition, and either to something faulty in the habits of life or to some unfairness in the conditions under which the eyes are exerted.

Conjunctival growths or tumours.

The conjunctiva may be the seat of morbid growths of various kinds, among which may be mentioned dermoid and sarcomatous tumours, the former sometimes bearing hairs. Such growths, if they are increasing, or unsightly or inconvenient, may be pinched up and removed by scissors, the resulting conjunctival wound being closed by a point of fine suture. If the wound is large the conjunctiva should be dissected from the sclerotic on either side, so that the edges may come together more readily. It is not uncommon to see subconjunctival collections of fat or of yellow fibrous tissue, and these, which are mostly situated on either side of the cornea, are sometimes nipped and moulded by the closure of the lids, so as to form little tumours, almost pedunculated, on the horizontal meridian. Such growths are harmless but unsightly, and they also may be excised with good effect.

Pterygium.

Another form of conjunctival growth is pterygium, which consists of a hypertrophy of tissue, sometimes very trifling in amount, sometimes very considerable, having a generally triangular outline, with its apex trespassing more or less upon the cornea. Pterygium is especially apt to occur in persons who have lived in the tropics. It is sometimes an original affection, sometimes a final result of long-continued inflammation, and it is but little amenable to treatment. The hypertrophied material may be removed by excision or ligature, but the same kind of action is often renewed in the cicatrix, and the patient seldom derives lasting benefit from any operation. A pterygium does no harm unless it extends so far over the cornea as to obstruct vision, and then the best course is to enlarge the pupil in the opposite direction by iridectomy.

Episcleritis.

An affection which is apparently conjunctival, but which is really seated in the tissue intervening between the conjunctiva and the sclerotic, is that which has received the name of Episcleritis, although it was formerly described as 'Sclerotitis with inflammation of the insertion of a rectus muscle.' It appears as an elevated patch of congestion, gradually fading into the natural level and appearance, and seated on the ocular surface near the corneal margin, most frequently on the temporal side and below the horizontal meridian. On close examination the congestion, with the exception perhaps of one or two dilated vessels, is seen to be subconjunctival, and to

be attendant upon a circumscribed but not sharply-defined swelling or thickening, which is adherent to the sclerotic, and which presents, in the interstices between blood-vessels, an appearance as if it consisted of some new deposit external to that membrane. The swelling is indolent, chronic, and in itself generally painless, although it is often attended by severe neuralgia. The subjects are most frequently women, and generally those who are anæmic or otherwise out of condition. Episcleritis may last for months with little change, and it seems to be harmless as regards the other structures of the eye. I have found it resist all treatment except the internal administration of mercury, and to this it will often yield in the course of a few weeks. I give the perchloride in solution, in the dose of a sixteenth of a grain three times a day, usually combined with five or ten minims of the tincture of perchloride of iron. With this treatment I am accustomed to combine a daily sprinkling of dry calomel over the swelling; but the internal medication is that which is most to be relied upon.

Diseases of the cornea.

The diseases of the cornea, in some instances, as already stated, are results of conjunctival affections; and the sloughing ulcers produced by purulent ophthalmia have already been mentioned. When the period of convalescence from purulent ophthalmia has been neglected, and when papillary granulations have been suffered to lurk in the palpebral folds, and ultimately to undergo shrinkage and degeneration, these conditions act as mechanical irritants to the corneal surface, and produce a development of vessels under the epithelium of a kind which, when it reaches a certain degree, is called 'Pannus.' The vascularization of pannus differs from other forms of vascularity in that the vessels proceed to the cornea from the conjunctiva as twigs or branches of some magnitude, and ramify upon the cornea in an irregular, arborescent fashion, with considerable intervals between them.

Pannus.

In these intervals, when they are tolerably large, the cornea may remain transparent; but, as the growth of vessels increases, the intervals diminish in size, and the epithelium covering them becomes cloudy and disturbed. When a vascular development of this kind is seen in the upper part of the cornea the upper lid should always be everted for examination, and in most instances its inner surface will be found roughened or granular. Where the upper lid only is at fault only the upper half of the cornea will suffer; but, if there are granulations also in the lower palpebral folds, the subepithelial vessels may extend over the whole cornea, and may reduce vision to a mere perception of light. The aggravated forms of pannus are chiefly seen among discharged soldiers, or among the sufferers from a great wave of epidemic ophthalmia which swept over Ireland a few years ago, or among persons who have had severe conjunctivitis in some dusty locality, away from medical aid. Cases come to the London hospitals from certain parts of Australia; and there can be little doubt that the contagious ophthalmia of the Hanwell Schools in 1862–65, and of the schools at Anerley more recently, will yield a crop of cases by-and-by. In order to be successful the treatment of pannus must be continued over many months, and it consists in the application, daily or at short intervals, of astringents to the lining membrane of the lids. The cornea must be left alone, for, if the condition of the lids can be greatly improved, the corneal vessels will gradually dwindle and disappear, and the transparency of the membrane will be restored. I have not seen benefit arise from very strong applications, nor from the long-continued use

of any single one, and am accustomed to ring the changes between lapis divinus, glycerole of tannin, and solutions of hydrochlorate of quinine, nitrate of silver, sulphate of copper, sulphate and chloride of zinc, and acetate of lead; the quantity of any salt not exceeding five grains to the ounce of distilled water. In order to make the application both lids should be everted, and their exposed inner surfaces either touched or painted with the selected medicament. If no benefit is obtained, and if the cornea is so generally vascular as to appear tolerably safe against sloughing, excellent results may sometimes be produced by inoculation with the pus of infantile ophthalmia. A little of this pus should be taken up by a probe or scoop, and placed in the conjunctival sac of the patient. The resulting purulent ophthalmia will require no treatment beyond frequent bathing and great cleanliness; and, after it has worn itself out, the cornea will usually clear in a very remarkable manner. It must be remembered that this treatment is not wholly free from risk, and that, notwithstanding the vascularity, it may produce sloughing of the cornea and total loss of sight. Inoculation is

Peritomy.

sometimes preceded by peritomy, or the excision of the annulus of conjunctiva and subconjunctival tissue which immediately surrounds the cornea, and which is dissected off the sclerotic as completely as possible with forceps and scissors. This operation is not attended by any immediate good results, but its ultimate effects are said to be often beneficial.

Corneal phlyctenulæ.

The phlyctenulæ, which have already been described as occurring upon the conjunctiva, occur also upon the cornea, where the morbid formation in which they originate is seated immediately under the epithelium. In this position, partly perhaps on account of the comparatively unyielding character of the tissues concerned, the little elevations occasion much more distress than when they are limited to the conjunctiva. Even during their period of formation, it is conjectured that they press upon or otherwise irritate the sensory nerve-filaments of the cornea; and, as soon as the elevations ulcerate, it is obvious that nerve-filaments may be exposed in the resulting solutions of continuity. The sensory filaments of the cornea, when irritated, produce photophobia, or intolerance of light; either because these filaments respond to the stimulus of light by common sensation, or else because they convey irritation to the ciliary region, and cause the reflex movements produced by light—the contraction of the pupil, and so forth—to be acutely painful. Whatever may be the explanation, the presence of even a single small phlyctenula on the cornea may occasion intense photophobia, and this, in its turn, may greatly aggravate the condition in which it has its origin. Sometimes before the elevation ulcerates, and always afterwards, a little leash of new vessels creeps from the conjunctiva to the affected spot, and these vessels only dwindle after the healing of the ulcer is complete. Each ulcer leaves behind at least a faint nebula, sometimes a more conspicuous and even a flattened cicatrix; and the cicatrices are united to the corneal margin by linear nebulæ marking the track of the vessels. Phlyctenulæ may occur in successive crops, extending over a long period of time, and they may then constitute an affection which is now commonly described as 'recurrent vascular ulcer' of the cornea, and which is apt to be exceedingly troublesome

Recurrent vascular ulcer.

and obstinate. Recurrent vascular ulcer is prominent among the group of diseases which were once described as 'strumous ophthalmia,' and the subjects are most frequently strumous children. There is, indeed, a great analogy between the history of follicular granulations or phlyctenulæ and that of tubercle.

Photophobia.

In some cases of recurrent vascular ulcer the photophobia is excessive. The child hides its head in the darkest corners or in its mother's dress, contracts its orbicular muscles with an energy by which the whole face is spasmodically contorted, and screams and struggles at every attempt to expose it to the light. If it is securely held, and its eyelids are forcibly separated, a gush of confined tears escapes, but the cornea is rolled upwards by the superior rectus, and often remains hidden from view. Under such circumstances the proper course is to relax muscular spasm by an anæsthetic, and then to make a careful and complete examination of the eye. If the case is already of some duration, and especially if the photophobia is of some duration, the cure of the muscular spasm is the first requirement, because this, by retaining tears and by exercising hurtful pressure upon the eye, is itself a serious obstacle to improvement. As a test of the severity of photophobia, and to distinguish spasmodic from voluntary contraction of the orbicularis, I am accustomed to place reliance on the presence of a little red chink, extending horizontally outwards from the external canthus. This chink shows that the muscular spasm has been sufficient not only to close the palpebral fissure, but also to hold two surfaces of skin in contact, and to convert them into something resembling mucous membrane. Whenever I see this chink I divide all the tissues, with one stroke of knife or scissors, from the external canthus right up to the margin of the orbit, on a horizontal line, cutting through conjunctiva, orbicularis muscle, and skin. There is always free bleeding from veins which had been previously congested by the muscular action, and the orbicularis loses its power to contract. The bleeding, which is probably highly salutary, stops of itself in a few minutes; and the only treatment required is to apply compresses wetted with cold or iced water, and to put the patient to bed in a dark or dimly lighted room. At the end of twenty-four hours it will almost invariably be found that the photophobia has disappeared, and that the eyes are accessible to inspection. The incisions heal without leaving any visible scars, and the power of the orbicularis is soon and completely restored.

Local treatment of recurrent vascular ulcer.

When the photophobia is not sufficient to require this treatment, but yet interferes with the comfort of the patient, he may be confined to dimly-lighted rooms when at home, and suffered to wear a thick veil or dark blue spectacles when abroad. A drop of a solution of neutral sulphate of atropia, of the strength of two grains to the ounce of distilled water, should be applied to the inside of the lower lid twice daily, by means of a goosequill cut to a blunt scoop; and a good deal of time, perhaps two or three hours a day, should be devoted to bathing the eyes with cold or iced water. When the stage of irritation connected with the development of an ulcer has terminated, and the period of healing is commencing, a little dry calomel may be sprinkled over the cornea once a day, or a morsel of Pagenstecher's ointment may be placed in the lower conjunctival sac.

General treatment.

The subjects of this disorder are nearly always feeble children of strumous tendencies, and they are often rendered even artificially unhealthy by the state of their eyes. Compelled to shun light, they have been deprived of its beneficial influence as a stimulus to vital action, and they have acquired a habit of stooping which gives them contracted chests and congested heads. Deprived of mental occupation, they have become dull and listless, and want of outdoor exercise has reduced their physical powers and their muscular tone. Very frequently their tempers have been spoilt by foolish indulgence, and their digestions impaired by over-feeding. Under such

circumstances it is often necessary for the surgeon, for a time, to make the necessary local applications himself, lest they should go anywhere but into the eyes; and it is always necessary to lay down minute rules for diet, habits, and exercise. Cod-liver oil, with or without steel or quinine, may generally be administered with advantage; and I have been accustomed to recommend skipping with a rope as a means of bringing the limbs into activity. It requires no vision, may be practised in any darkened but well-ventilated room, and it employs many muscles at once. Care must be taken, however, not to occasion over-fatigue at the beginning of the treatment.

Setons.

In some children, notwithstanding all that can be done, the disease is very obstinately recurrent. In such cases the late Mr. Critchett advocated the use of setons in the hairy scalp, just above the ears. He inserted a single thread of rather thick silk through a needle-track about an inch in length, and knotted the ends loosely together. By inserting the seton in the hairy scalp not only is the loop itself rendered inconspicuous, and the resulting scar invisible, but the operator is able to lift up the skin from the deep fascia by the hair before passing the needle, and thus to avoid all risk of wounding the temporal vessels. Some persons insert the setons below the hairy scalp in front of the ear, but this practice is much to be condemned, especially for girls, on account of the unsightly cicatrices which are produced. Mr. Critchett believed that the setons establish an artificial weak place in the neighbourhood of the eye, and that they thus break the habit of morbid action. They may be left in the temples for six months or longer, and re-inserted if they cut their way out prematurely. In a small number of cases they are extremely useful, but they are employed in many instances which would yield perfectly well to the judicious use of milder remedies.

Iridectomy.

In young adults, especially in young women, recurrent vascular ulcer sometimes continues even for years, and in these cases the ulcers are often sufficiently deep to leave permanent and flattened cicatrices, so that the corneæ become dotted over with opacities and distorted in outline. Under such circumstances the chain of morbid action will usually be broken by an iridectomy, and for this purpose it is sufficient to excise a very narrow strip of iris, which should generally be taken from behind a clear part of the cornea. When this has been done not only will the recurrence of ulceration cease, but the cornea, in the course of a few months, will often clear in a surprising degree.

Inflammation analogous to recurrent vascular ulcer.

We meet with a few instances, chiefly in strumous children, in which conditions analogous to recurrent vascular ulcer produce an extension of vessels upon the cornea, but no ulceration. In such cases we find here and there a faint corneal nebula, in which a lens will still discover fine vessels, and in another place there is an arborescent encroachment of vessels from the margin towards the centre, attended with some intolerance of light. A careful scrutiny will generally discover, at some point of the corneal margin, a narrow zone of thickened and pellucid tissue, formed by something resembling little beads or dots, and clearly of the same character as the ordinary phlyctenulæ, but not tending to ulceration. In all such cases the local and general treatment required for mild cases of vascular ulcer may be applied with advantage.

Keratitis.

The cornea is liable to several forms of inflammation, which are grouped together under the general term keratitis, and are conveniently divided into the vascular, the interstitial, and the suppurative. All these forms of inflammation are attended, at their onset and throughout their course, by hyperæmia of the conjunctiva, but this hyperæmia is never limited to the conjunc-

tiva. The vessels either extend over the corneal margin, or else there is congestion of a fine vascular zone in the sclerotic which immediately surrounds the cornea, so that, if the blood is pressed out of the conjunctival vessels by a finger, in the manner already described, the finger-track is not white but pink. It is very important to observe and to attend to this distinction; for, while astringents are useful in all the mild forms of conjunctivitis, they are always hurtful, and often very hurtful, in the early stages of keratitis.

Vascular keratitis

Vascular keratitis commences by the development of two fine crescents of vessels, one usually at the superior and the other at the inferior margin of the cornea. These crescents appear, in the first instance, as fine red lines, and gradually increase in size, invading more and more of the corneal tissue. Examined by a lens each crescent is seen to consist of a congeries of minute blood-vessels, situated immediately beneath the epithelium, and so closely packed together that the interstices which separate them are scarcely discernible by the naked eye, which perceives only a general effect of redness. The crescents are a little elevated above the natural surface of the cornea, and each one pushes before it, so to speak, a margin of precursory epithelial turbidity. Unless this precursory turbidity reaches the central portion of the cornea, so as to cover the pupil, sight is scarcely at all affected; and, as a rule, there is little or no pain, and little or no intolerance of light. In cases of a severe character, or which have been aggravated by improper applications, the vascular crescents may ultimately coalesce and cover the whole of the cornea, which then becomes uniformly red and opaque, so that vision is almost entirely abolished. After a longer or shorter time the vessels begin to dwindle, and they ultimately disappear, leaving behind them a dense opacity of a very enduring nature. When the whole of the cornea has been invaded the opacity is usually most dense over the central parts; and, in consequence of the greater distance of the centre from the sources of blood-supply, absorption progresses more slowly there than elsewhere; so that a bad case, even under the most favourable circumstances, must involve loss of sight for a very considerable period of time. Vascular keratitis sometimes attacks both eyes at once, and sometimes one only; but in cases of the latter class I have frequently seen the second eye become affected in the course of time, even after an interval of three or four years.

Treatment of vascular keratitis.

The chief object of treatment, in vascular keratitis, is to arrest the progress of the disease before it has reached the central region of the cornea, and for this purpose the first essential is a negative one, namely, the avoidance of irritants. If the case, in its early stages, is mistaken for simple conjunctivitis on account of conjunctival hyperæmia which attends it, and if this error leads to the application of nitrate of silver or of sulphate of zinc lotion, or of any of the other stimulants or astringents which conjunctivitis would require, the keratitis will always be much aggravated, and will often be rendered uncontrollable. In every case of apparent conjunctivitis it is necessary to scrutinise carefully the upper and lower margins of the cornea; and whenever a fine network of vessels can be seen creeping over either of these margins all astringents must be withheld. The only local application which should be used in such cases is atropine, and it should be applied in the form of a two-grain solution, two or three times a day. It is not only valuable as a local sedative, but it paralyses for a time the muscle of accommodation and the sphincter of the pupil, and thus procures functional rest for the eye.

Compression bandage.

In addition to functional rest, the movements of the eyelids over the affected surface should be restrained by the careful application of a compress of carded cotton-wool, retained by a bandage. The closed lids should first

be covered by a small piece of fine soft linen rag, in order to prevent mechanical irritation of the eye by fibres of wool, and over this rag the wool should be so adjusted as to fill the orbital hollows, and to form a covering through which a bandage will exert uniform compression. The bandage should be nearly two yards long, about an inch and a half wide, and made of some loose elastic texture, what is called 'water-dressing bandage' being the best for the purpose. The end of the roller is placed on the forehead, immediately above the affected eye, and is secured by one horizontal turn, which passes across the forehead and round the head. When the roller reaches the forehead, over the sound eye for the second time, it is inclined downwards under the lobe of the ear on the same side, round the occiput, under the lobe of the ear on the affected side, and over the wool-pad to the horizontal turn, to which, when the degree of pressure is properly regulated, it is secured by a pin. Another horizontal turn is then made over all, and the bandage is complete. If properly applied, it is scarcely at all liable to slip, but when it is required at night it is the safest plan to stitch the folds together at intervals. This applies chiefly to operation cases; and in inflammation of the cornea the bandage may generally be laid aside during sleep, when the lids will be quiescent without its aid.

Cold applications.

An important influence upon the development of vessels in the cornea may often be exerted by temperature, cold applications being highly valuable to diminish vascularity, and hot applications to increase it. In the early stages of vascular keratitis it will often be useful to bathe the closed lids with cold or iced water, or even to apply to them small linen compresses wetted with iced water, and frequently renewed. For these purposes the compressive bandage may be laid aside for half an hour or an hour, two or three times a day, the use of cold for longer periods being seldom desirable.

Counter-irritation.

In many cases I have seen great benefit arise from counter-irritation; and the agent which I commonly employ for this purpose is an iodine liniment, of a strength adapted to the degree of irritability of the skin, and in which a little morphia, perhaps a grain to the ounce, is dissolved. I usually begin with the tincture of iodine, painted over the brow and temple of the affected side every night, and strengthened if it fails to irritate after one or two applications.

General health to be considered.

In nearly every case of vascular keratitis the general health of the patient will require careful consideration and treatment; and in a considerable proportion there will be evidence of a syphilitic taint, either inherited or acquired. In such instances the administration of mercury or of iodide of potassium, according to the circumstances of the case, will be imperatively called for; while in others iron, or quinine, or bromide of potassium, or cod-liver oil, may be the more appropriate remedies. It may be laid down as a general principle that, when the disease is spreading over the cornea, notwithstanding the administration of any of the latter, they should be experimentally laid aside in favour of an anti-syphilitic medication; and also that the surgeon should not persevere too long in any plan which does not appear to be beneficial, but should consider the whole case with a view to more effectual action.

Iridectomy.

When the inflammation extends in spite of all treatment, and covers the central portions of the cornea with vessels, or even with the turbidity precursory to the advancing vascular crescents, iridectomy should be performed in a direction inwards and a little downwards. The operation appears to exercise a distinctly controlling effect over the course of the malady, and it leaves a lateral pupil through which, as the opacity of the cornea diminishes, vision will be obtained long before the central parts are clear.

When the progress of the disease is arrested, the disappearance of the new vessels leaves the parts which they occupied in a state of peculiarly dense opacity. As soon as the stage of progressive increase is over, and that of decline has commenced, the atropine and the closure of the eyelids may be discontinued, and the cold compresses may be replaced by hot fomentations, which will tend to diminish the density of the opacity by promoting absorption and tissue-change. During the period of recovery and convalescence the general treatment must be continued, and the health of the patient promoted by suitable air, exercise, and habits of life. When all inflammatory action has ceased the absorption of residual opacity may often be greatly promoted by injecting under the conjunctiva a few minims of a solution containing ten grains of common salt to an ounce of water. The injection may be made with an ordinary hypodermic syringe (a fold of conjunctiva being pinched up with forceps to allow the needle-point to pass freely between that membrane and the sclerotic), and it may be repeated every fortnight or three weeks. If iridectomy has not been performed during the acute stage it will often be required afterwards, on account of the more rapid clearing of the marginal parts of the cornea, for the restoration of vision at an earlier period than by natural processes, or even on account of the central parts of the cornea being altered in curvature by the disease. Such alteration may be of two kinds: flattening from the shrinkage of the effused material, or increased convexity from the general yielding of the softened membrane to the intraocular tension. From its long duration, and from the character and permanence of the changes which it may produce, severe vascular keratitis is a most formidable affection, and one which can hardly be too carefully treated in its incipient stages, so that, if possible, it may be arrested before the part of the cornea directly concerned in vision is involved.

Treatment of the residual corneal opacity.

Interstitial keratitis is the form of inflammation of the cornea which occurs in children and young persons who are the subjects of inherited syphilis. It was first accurately studied, and its specific character made known by Mr. Jonathan Hutchinson, who has described it in the following words:—

Interstitial keratitis.

'Chronic interstitial keratitis usually commences as a diffuse haziness near the centre of the cornea of one eye. There is at this stage no ulceration, and exceedingly slight evidence of the congestion of any tunic. The patient, however, almost always complains of some irritability of the eye, as well as of dim sight. If looked at carefully the dots of haze are seen to be in the structure of the cornea itself, and not on either surface; they are also separate from each other, like so many microscopic masses of fog. In the course of a few weeks, or it may be more rapidly, the whole cornea, excepting a band near its margin, has become densely opaque by the spreading and confluence of these interstitial opacities. Still, however, the greater density of certain parts—centres, as it were, of the disease—is clearly perceptible. Early in this stage the comparison to ground-glass is appropriate. There is now almost always a zone of sclerotic congestion, and more or less intolerance of light, with pain around the orbit. After from one to two months the other cornea is attacked and goes through the same stages, but rather faster than the first. A period in which the patient is so far blind that there is but bare perception of light now often follows, after which the eye first affected begins to clear. In the course of a year or eighteen months a very surprising degree of improvement has probably taken place. In milder cases, and under suitable treatment, the duration may be very much less than this, and the restoration to transparency complete, but in many instances patches

of haze remain for years, if not for life. In the worst stage the corneal surface looks slightly granular, and from the very beginning it has lost its polish, and does not reflect images with definite outlines. In certain cases, after the ground-glass stage is passed, a yet more severe one ensues, in which the whole structure of the cornea becomes pink or salmon-coloured from vascularity, and in these crescentic fringes of vessels are often noticed at its circumference. In the best recoveries the eye usually remains somewhat damaged as to vision, and often a degree of abnormal expansion of the cornea is apparent. Only in one or two cases have I ever observed ulcers of distinguishable size on the surface of the cornea, and I have scarcely ever seen pustules on any part of it.'

Characteristics of inherited syphilis.

Mr. Hutchinson has also described the facial and other characteristics by which the subjects of inherited syphilis may be known, and the most important of these characteristics is a peculiar malformation of the teeth, and especially of the two central permanent incisors of the upper jaw, which are bounded laterally by curved outlines with their convexities outwards, and present crescentic notches on their lower borders. The lateral incisors of the upper jaw are often similarly deformed, and the incisors of the lower jaw misshapen, dwarfed, and 'peggy'; but the upper central incisors are those in which the peculiar shape may be regarded as pathognomonic. Together with the altered teeth there is often a peculiar flattened or almost concave physiognomy, arising from projection of the frontal eminences and imperfect development of the nose, the alæ of which, as well as the angles of the mouth, are frequently seamed by cicatrices. The complexion is earthy and peculiar, the frame often stunted, the whole aspect withered and prematurely senile. In such children the interstitial keratitis usually makes its appearance at about the tenth year of age—sooner or later, according to the degree of the inherited taint; and, where this degree is slight, the keratitis may be postponed even until adult age, or until it is developed by circumstances which affect the health injuriously.

Treatment.

The general treatment of interstitial keratitis is that of a chronic syphilitic affection, which requires mercury, or perhaps iodide of potassium, combined with tonics and wholesome living. The perchloride of mercury is, perhaps, the best preparation, and it may be combined with perchloride of iron and with cod-liver oil. After a time it may be laid aside for iodide of potassium, or given alternately with it, and this salt may be combined with the ammonio-citrate of iron. The local treatment must be entirely of a soothing character. Atropine should be applied, either in the usual watery solution or dissolved in vaseline; strict rest of the eyes should be enjoined, and they should be protected from strong light, heat, dust, and cold winds. If any irritant is applied to them there will be great danger of the development of an acute vascular keratitis, which will often be attended by iritis. If any intolerance of light should occur under proper treatment it will call for a short period of confinement to a darkened chamber, and for frequent bathing with cold water. It is always proper to warn friends and parents, at the beginning, of the constitutional character of the malady, of its chronicity, and of the high probability that the second eye will be attacked subsequently to the first; but it will seldom be desirable to raise the question of syphilis. With due care as to what is avoided, as well as to what is done, the prognosis may in nearly all cases be favourable.

Suppurative keratitis.

The suppurative or destructive form of keratitis may commence in the anterior layers of the membrane, producing ulcer, or in the central layers, producing abscess. Abscess of the cornea appears as a circumscribed opaque

spot, originally of a greyish colour, attended by hyperæmia of the conjunctiva, usually with slight encroachment of vessels upon the corneal margin, by a good deal of neuralgic pain, not only in the eye but in and around the orbital region generally, and by impairment of sight corresponding to the size, the colour, and the situation of the opacity. The encroachment of vessels is not in crescents, as in vascular keratitis, but is either all round the margin or else, when the opacity is eccentric, at the part of the margin to which it is nearest. The opacity itself is often very tender to the touch of a probe; and, especially in patients past middle age, there may be a good deal of constitutional disturbance. As the case progresses, the colour of the centre of the opacity changes from grey to a pus-yellow, and the pus may either separate the laminæ of the cornea, and gravitate between them, forming the condition called 'onyx': or it may discharge itself externally, leaving an ulcer; or it may discharge itself internally into the anterior chamber, forming there a collection known as 'hypopyon.'

Abscess of cornea.

When abscess of the cornea is only threatened, the objects of treatment are to prevent the formation of pus and to procure resolution. When pus is actually formed the object is to permit its discharge with the least possible injury to the corneal tissue. The abscess usually resembles a boil in its essential characters, the suppuration being due to the formation of a core or slough; and the pus of hypopyon is often of a firm and tenacious consistence.

Treatment of corneal suppuration.

In order to prevent or to limit suppuration, the ordinary requirements are rest and shelter, together with such local and general treatment as the state of the patient may demand. If there is active local congestion, with elevation of temperature, a leech may be applied just outside the orbital margin, near the outer canthus, and cold or iced compresses over the closed lids; while, if there is a more passive state of the circulation, hot fomentations may be advisable. If the tongue is foul, or if the bowels are loaded, a purgative should be given; and this should generally be followed by some active tonic, such as iron or quinine, or both in combination. If, notwithstanding treatment, the local pain continues, and the centre of the opacity assumes a yellow colour, which indicates the presence of pus, the abscess should be opened without delay. For this purpose, if the purulent deposit is near the anterior surface of the cornea, a cut may be made through this surface with the point of a cataract-knife; and, if the pus appears to be nearer to the posterior surface of the cornea, a fine flat two-edged needle may be passed into the anterior chamber from near the corneal margin, and its point made to enter the cavity of the abscess. When this course is adopted a probe should be introduced into the external wound after the needle is withdrawn, as in paracentesis, to permit the complete escape of the aqueous humour and of any purulent matter which it may contain, and this should be repeated at least once a day, until the cavity of the abscess is completely evacuated and healing has commenced. Whether an internal or an external opening is made, the eyelids should be separated by a spring speculum, and the eyeball should be securely fixed by forceps, as without these precautions the surgeon would be liable not only to open the abscess but also to divide the whole thickness of the cornea, a proceeding which it is one of the objects of an early incision to avoid.

Extended suppuration.

When an early incision has not been practised, the limits of the abscess may extend themselves by separation of the corneal laminæ, in which case, however, the general tendency of the pus will be to gravitate downwards towards the lower margin, where it has been called 'onyx.' from a fancied

resemblance to the lunula at the base of a finger-nail. It is not always easy at first sight to distinguish onyx from hypopyon, or pus in the anterior chamber, but the point may generally be determined by an examination of the eye in profile; and, when seen from the front, the diagnosis rests upon obvious physical characters. The pus of an onyx, supported by the corneal laminæ, may have an irregular or convex superior boundary, while that of an hypopyon must have a level and horizontal superior boundary, except that when very small in amount it may be a mere crescentic line along the lower margin of the anterior chamber. In the case of onyx the wider extension of the pus is only an additional reason for its evacuation before it has had time to do more mischief, and it should generally be let out through the external surface. When pus has escaped from the cornea into the anterior chamber it will often, in the case of children, be absorbed without doing mischief; but in adults, and especially in persons past middle age, it is apt to set up acute iritis, and greatly to aggravate the pre-existing conditions. In such persons the pus should be immediately evacuated by a free incision into the anterior chamber, from which, if coherent, it should be removed with forceps; and at the same time, if iritis has commenced, a large piece of iris should be excised. The incision should always be so placed that the iridectomy, if required, may be behind a clear part of the cornea, so that it will be useful as an artificial pupil if the opacity left by the abscess should obscure the natural one.

Acute ulcer of the cornea.

When abscess of the cornea discharges itself internally it does so, in most instances, by a minute fistulous track, which can often be seen as a faint white line leading downwards to the hypopyon from the original cavity. But when it discharges itself externally the whole of the corneal tissue in front of the abscess usually perishes, leaving an ulcer of corresponding extent. Such an ulcer, when fully formed, is not distinguishable from one in which the process of disintegration has commenced upon the surface, either without apparent cause or as the result of injury. Traumatic ulcers of the cornea occur chiefly in old people, in whom wounds, instead of undergoing speedy repair, take on sloughing action; and they are common among men who are employed in trimming hedges or in cutting down copse-wood, and who are very liable to be struck upon the eye by a twig or thorn. However occasioned, corneal ulcers differ much in their rate of progress; but they present three chief types, in the first of which there is a very rapid disintegration of tissue, the floor and edges of the ulcer remaining transparent, or nearly so. In the second, in which the disintegration is less rapid, the floor and margins of the ulcer are turbid, a certain amount of effusion or cell-proliferation surrounding and anticipating the destructive process. In the third, vessels are seen running across the cornea to the margin of the ulcer, and these vessels generally indicate the commencement of the repair for which they convey the nutritive materials. In ulcers of the first type the appearance of turbidity around the margin is the first indication of the commencement of the healing process, and to this, if the progress of events is favourable, the development of vessels is soon superadded.

Their situation and progress.

The situation of corneal ulcers differs much in different cases, but when they occur independently of injury they are most frequent in the lower half of the cornea, which is not under the shelter of either lid. When traumatic, the locality of their occurrence is necessarily that of the injury, and there is a form of spontaneous ulcer which cuts out a circular groove around the margin of the membrane, and trephines, so to speak, its central portion. Another form of ulcer, which Prof. Saemisch has thought worthy of the

special designation of 'creeping' (ulcus serpens), is described by him as extending itself in one direction only, so that in section its outline would be precipitous on one side and sloping down to the uninjured tissue on the other. The ill effects of corneal ulcers depend partly on their superficial extent, partly on their tendency to perforate. The lost tissue is never reproduced, but is replaced by an opaque cicatrix, which undergoes gradual contraction, so that, in proportion to the size of the ulcer, there will be an unsightly white spot and a flattening of the corneal curvature. In proportion to the depth of the ulcer will be the loss of power of its floor to resist the pressure of the intraocular tension, and hence the floor often becomes convex and prominent, and may ultimately yield, so as to permit the escape of the aqueous humour and the contact of the iris with the perforation. The structureless lining membrane of the cornea (membrane of Descemet) is never destroyed by ulceration; and if it is allowed to burst, its shreds may line the sides of the opening in such a manner as to prevent their adhesion, and to occasion the formation of a troublesome fistula. Unless this should occur the perforation of an ulcer is nearly always the end of the destructive stage, and the signal for healing to commence.

Cicatrices. Staphyloma.

The cicatrix which follows a perforating ulcer is formed, in the first instance, by the iris, which falls against the opening and becomes adherent to it, and is presently coated with effused lymph, which gradually becomes organised and forms a cicatricial tissue through which the colour of the foundation of the iris can be seen. If the opening is very large, as when the whole or the greater part of the centre of the cornea is destroyed, the resulting cicatrix has a bluish, semi-transparent aspect, and, by reason of its want of firmness, a tendency to bulge under the pressure of the ocular muscles. The resulting protrusion, from some fancied resemblance to a grape, was called 'staphyloma' by old writers, and the name may be looked upon as established by long usage. A staphyloma tends to increase by gradually undergoing extension, and by taking up into itself any margin of sound cornea by which it may be surrounded, until it often becomes very large and unsightly. When the perforating ulcer is small the resulting cicatrix may be a mere dot, with less tendency to contraction than it would have had if formed entirely of corneal tissue; and when the ulcer is of middle size the cicatrix may incline to either of the foregoing characters. It may be firm and strong, maintaining its level and leaving the other parts of the eye only little injured; or it may be weak and distensible, inclined to increase in size at the expense of the remaining parts of the cornea. In the latter case it is often called a 'partial' staphyloma.

Treatment of acute corneal ulcer.

The principles of treatment, in all forms of corneal ulcer, are to arrest the destructive stage and to promote the commencement and progress of repair, to support the cicatrix against the tension of the muscles, and to aid in its consolidation, and eventually, as far as may be either necessary or practicable, to improve vision and to conceal disfigurement.

For the fulfilment of the first of these indications, the resources of ophthalmic surgery have been increased, within the last few years, by the discovery of the power of eserine to limit and control the extension of the ulcerative process, and hence, in the treatment of corneal ulcer, atropine has been entirely superseded. Eserine is the active principle of the Calabar bean, and its salts are readily soluble in distilled water. Those most commonly employed are the sulphate and the salycilate, and there is little or no difference in their action. Either may be used in a solution of the strength of

four grains to the ounce; and a drop of this solution may be inserted within the conjunctival sac twice or thrice a day. Eserine produces extreme contraction of the pupil, but its effect upon ulceration is believed to be independent of this, and to be due to its power of arresting the migration of white corpuscles. The pupillary contraction is in one sense a disadvantage, because, by placing the whole of the pupil behind the ulcerated and opaque portion of cornea, it appears to render the vision worse than it was before the eserine was applied.

Besides the application of eserine, it is necessary to prevent friction of the lids by a well-applied compressive bandage, to promote vascular development by the employment of hot fomentations, and to sustain the general nutrition by suitable diet and by the use of stimulants and tonics. If, in spite of these precautions, the ulcer should deepen and extend, it is proper to anticipate perforation, and to bring about the healing by which it is followed, by means of an artificial opening. If perforation is imminent, and the membrane of Descemet is actually bulging through the floor of the ulcer, it may be ruptured by thrusting a probe obliquely through the prominence into the anterior chamber, so carefully as to run no risk of wounding the lens, and so as to direct the shreds of the torn membrane inwards, and to prevent them from lining the aperture. But in most cases the artificial opening should be made at an earlier period. Professor Saemisch has advocated the division of the floor of the ulcer by transfixing the cornea with a linear cataract-knife and then cutting outwards through the intervening tissue; the lips of the wound to be separated daily, for the first few days, by means of a probe or other suitable blunt instrument. My own experience is not favourable to this plan, which in my hands has produced weak and irritable cicatrices; and I much prefer the performance of iridectomy, the piece of iris excised being behind the broadest part of clear cornea, where the resulting artificial pupil is most likely to be useful for purposes of vision. In some cases I have seen an iridectomy, almost or altogether without other treatment, check the progress of an ulcer and lead to favourable healing. When repair has commenced, it must be remembered that the chief remaining danger is that the cicatrix will yield to the pressure from within and become staphylomatous; and this must be guarded against by a firmly-applied compressive bandage, worn not only until the time of healing, but also until a certain amount of consolidation of the cicatrix is completed. If the scar constitutes a conspicuous deformity, which is either disfiguring in appearance or likely to be an obstacle in the way of the patient's prospects in life, it may be almost entirely concealed by being carefully tattooed with Indian ink, which must be mixed with water to a creamy consistency, and then pricked into the mark by repeated punctures with a fine needle. If vision is much impaired, and if iridectomy has not been performed, or has been performed in an unsuitable position, an artificial pupil may be made behind a selected part of the cornea; but neither the artificial pupil nor the tattooing should be attempted, as a rule, for six months after the formation of the cicatrix.

Treatment of complete staphyloma.

When a corneal ulcer produces complete staphyloma, the prominence is often painful as well as unsightly; and it is usually desirable to remove it, in order to make room for an artificial eye. Enucleation of the eyeball should not be practised in these cases, but the portions posterior to the ciliary body should be left, in order to afford a better foundation for the artificial eye than can be obtained from the muscles alone. The original operation for staphyloma consisted simply in shaving off the projection with

a Beer's cataract-knife, the gaping wound being left to close in its own time. Mr. Critchett improved on this method by inserting three or four semicircular threaded needles behind the projection, then cutting it off, drawing the needles through and tying the thread, so as to obtain prompt union in a horizontal line. Other surgeons have passed sutures through the conjunctiva only; but the union thus produced is apt to be feeble, and I have seen Mr. Critchett's operation followed by sympathetic ophthalmia of the remaining eye, probably because a ciliary nerve was lacerated by one of the needles. The plan which I prefer is to divide the conjunctiva all round, close to the margin of the staphyloma, and to dissect it from the sclerotic nearly to the equator; then to detach the four recti muscles, and to cut off the front portion of the eyeball, well behind the ciliary region. The superior and inferior recti should then be united in front of the wound by a catgut suture, and the internal and external recti in front of them; and the conjunctival incision should be brought together in a horizontal line by silk sutures. The resulting stump is of good size and very mobile, so that an artificial eye placed upon it will scarcely betray itself even to a not wholly unskilled observer.

Treatment of partial staphyloma.

The formation of a partial staphyloma, instead of a firm cicatrix, is generally due to neglect or premature abandonment of support during the healing process. An attempt may be made, in such cases, to check yielding by a large iridectomy (which will diminish pressure from within) and by renewed and persevering bandaging; but in the majority of cases the protrusion will increase, will take up into itself more and more of the cornea, and will become irritable or painful, and threatening to the sound eye. Under such circumstances, even although some imperfect vision may remain, it is best to treat the case as if the staphyloma were complete, and to remove the diseased parts by one of the operations last described.

Conical cornea.

The only other corneal affection which requires description in these pages is the malformation known as 'conical cornea.' This is, in effect, an atrophy of the central portion of the membrane, which becomes thinned and weakened, loses its natural curvature, and projects as an obtusely pointed prominence. When seen in profile the distortion of shape is very apparent; and when seen from the front it has a curious pellucid appearance, almost as if a drop of some highly refracting liquid were adherent to the corneal surface. When the prominence attains large dimensions its apex loses the protection of the lids, and is exposed to many sources of irritation, so that it often loses its transparency, and becomes cloudy and opaque. When once established, conical cornea tends to progressive increase under the pressure of the recti muscles, and it soon becomes highly disturbing to vision. On account of the elongation of the eyeball it produces a high degree of myopia, or near sight; and, on account of the irregularity of the elevation, this near sight cannot be materially assisted by any concave lens. Whenever near sight is attended by unusual diminution of the acuteness of vision, and is not relieved by spectacles, conical cornea should be suspected and looked for. In its early stages it may easily escape detection; but Mr. Bowman has pointed out that it may be easily discovered by an examination with the mirror of an ophthalmoscope. The area of the pupil does not present an unbroken circle of equal illumination, but some part of the base of the prominence will appear to lie in shadow, and this shadow will play around, from side to side, in response to slight movements of the mirror.

The treatment of conical cornea is based upon the tendency of an ulcer

Treatment of conical cornea.

to flatten the curvature of the membrane during the healing process. The idea of utilising this tendency occurred first to Von Graefe, who shaved off the apex of the cone without penetrating the anterior chamber, cauterised the wound until he had produced an ulcer of sufficient extent, and then promoted healing. Other surgeons have cut off the thinned central portion of cornea, and some have united the edges of the incision by a point of suture. Mr. Bowman has contrived an ingenious trephine by which it is possible either to cut out a circular disc of the anterior layer of the cornea, and to peel this off, leaving the membrane of Descemet intact and the anterior chamber unopened, or to carry the cut deeper, so as to remove the whole thickness. My own practice is either to use this trephine or to transfix the apex of the projection with a narrow two-edged knife, so as to cut off, by a single thrust, the small portion of cornea which remains in front of the blade, and which should seldom exceed a line in diameter. It is not very material whether the whole or part of the thickness of the cornea is taken away; but partial removal is only practicable in comparatively slight cases, where the thinning of the projection is not extreme. Prior to the operation the pupil must be fully dilated by atropine, in order to prevent its margin from becoming adherent to the cicatrix. The lids should be closed by a compressive bandage, and a liniment of glycerine and belladonna applied to the brow, so as to maintain dilatation. When the case progresses favourably the result will be a firm central cicatrix, which will restore the cornea to normal curvature, or nearly so, and will arrest the further increase of the conicity, but which is both unsightly and an obstacle in the way of vision. In order to restore sight it is necessary to make an artificial pupil behind some transparent part of the cornea; and the cicatrix may be concealed by tattooing it with Indian ink in the manner already described.

Diseases of the sclerotic.

In some of the older text-books of ophthalmic surgery, considerable prominence is given to diseases of the sclerotic, but the tendency of the more exact knowledge of recent times has been to reduce the group so-called to very insignificant dimensions. Excepting in a narrow annulus immediately around the cornea, the sclerotic is almost entirely extra-vascular; and hence any real inflammation of it is almost confined to this particular region, where it may occur as a complication, or as a part, of some of the more severe forms of iritis and keratitis, and always when either of these affections extends to the ciliary body. In such cases, we often see the sclerotic undergo inflammatory softening, as a result of which the ciliary region may be much altered in shape, yielding to the distension of the eyeball and to the traction of the recti muscles, and becoming considerably elongated. Occasionally, the sclerotic may be so much softened and thinned as to bulge into irregular prominences around the cornea, generally under the upper lid; and this condition is described as sclerotic staphyloma. The inflammations of the sclerotic thus arising call for no other treatment than that demanded by the more important inflammation of the cornea, the iris, or the ciliary body, with which they are associated; except that any evidence of yielding of the sclerotic would be a reason for the performance of iridectomy, in order to preserve the shape of the eyeball by diminishing tension. It was once believed that the sclerotic, in its character of a fibrous membrane, was especially prone to gouty or rheumatic inflammation; and it is perhaps true, although certainly not proved, that the tendency of iritis or of keratitis to extend to the anterior sclerotic zone is more marked in persons of gouty or

Their rheumatic character.

rheumatic diathesis than in others. The possibility is at any rate sufficient to require, in all these cases, an investigation of the tendency to lithic acid formation, and the use of appropriate remedies when this tendency is discovered. A large proportion of the cases of supposed rheumatic or gouty ophthalmia, however, are simply cases of the sub-acute or remittent form of glaucoma; and the pain associated with them is not rheumatic, but only tensive. Vision has been irretrievably lost, in hundreds of cases, because a belief in the rheumatic character of these affections has interfered with the timely performance of iridectomy; and the proposal to adopt the epithet 'rheumatic' in any form of eye-disease, is one which should be scrutinised very closely before it is accepted as a guide to practice.

The bulging outwards of the sclerotic, near the entrance of the optic nerve, which, in cases of extreme myopia, is sometimes associated with atrophy of the choroid in the same region, has been attributed to inflammatory action, and has been supposed to afford evidence of a 'sclerotico-choroiditis posterior'; but it is quite possible that the effect in question may be due to mechanical causes. The posterior pole of the eyeball is necessarily rendered tense by the convergence incidental to extreme myopia; and the tension thus occasioned must necessarily tend to produce thinning and stretching of the ocular tunics.

Sclerotico-choroiditis posterior.

The iris is liable to be the seat of tumours or cysts of various kinds, which, when they are increasing, may produce destructive changes in the eyeball by their pressure upon the lens and ciliary body, by projecting into the pupillary space, and by general interference with the circulation and nutrition, and which should be completely removed, together with the portion of iris on which they are seated, as soon as their character is declared, and before they have attained sufficient magnitude to be seriously injurious. Many endeavours have been made to destroy cysts by simple laceration; but these endeavours have scarcely ever been successful, and have sometimes set up inflammation of a destructive character. When any morbid growth of the iris has been removed, it should be made the subject of careful microscopic examination; and, if it appears to be malignant, enucleation of the eyeball should generally be recommended.

Diseases of the iris. Cysts, or morbid growths.

The iris is also liable to a congenital malformation by deficiency, usually in a direction downwards. The resulting gap is called a coloboma, and may vary in extent from a mere notch in the margin of the pupil to a loss of substance which may extend through the ciliary body and choroid to the border of the optic nerve. Coloboma may affect either one or both eyes; and, as usually seen, it somewhat resembles the effect of an iridectomy.

Coloboma.

The most important disease of the iris, and also one of the most common of the affections of the eye, is inflammation of the substance of the membrane, or iritis. Iritis is seen under two chief forms, the plastic and the serous, of which the first-named is much the more frequent. Plastic iritis, in its early stages, is liable to be mistaken for simple inflammation of the conjunctiva, from which it may be distinguished by three chief signs, namely, that there is always some loss of lustre of the iris, some impairment of vision, and some congestion of the zone of fine sclerotic vessels which surrounds the cornea, so that the pressure of the finger through the eyelid does not leave a perfectly white tract behind. In every case of apparently trivial conjunctivitis it is necessary to ascertain the absence of iritis with scrupulous care, because the astringent lotion which would cure the former

Iritis.

Plastic.

affection would be certain to stimulate the latter to greatly increased activity.

The early progress of iritis is somewhat rapid, and, as a rule, when a case comes before the surgeon the diagnosis is no longer doubtful. In addition to the symptoms already mentioned the iris will appear dull and discoloured, in consequence of discolouration of the aqueous humour in front of it, and the movements of the pupil in response to variations of light will be sluggish, or even altogether arrested. In order to determine this point the sound eye should be effectually covered, and then the surgeon, without touching the affected one, should shade it with his hand, removing and replacing the hand two or three times, and carefully watching the pupillary margin. If expansion and contraction should not take place, a drop of solution of atropine should be applied to the lining membrane of the lower lid, and this, in most instances, will bring to light irregularity of the pupil, showing that it is in points adherent to the surface of the crystalline lens, and that it can only dilate in the intervals between such adhesions, and in some such manner as that which is shown in the annexed diagrams. A deceptive resemblance to iritis is produced in some cases of turbidity of the cornea; but if a drop of four-grain solution of atropine produces complete dilatation of the pupil within twenty minutes or so, it may be concluded that no iritis is present; and, on the other hand, the appearance of points of adhesion establishes the diagnosis of iritis with certainty. The only exception would be in a case in which the adhesions had been left behind by some former attack, and in which the condition actually present might be simple conjunctivitis or keratitis.

Causes. The causes of iritis are very numerous; but the malady is so frequent an attendant upon the earlier stages of secondary syphilis that the syphilitic

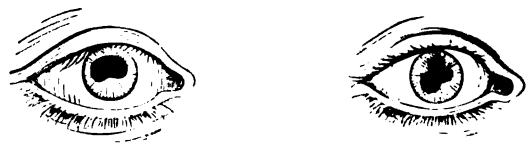


Fig. 335. Effects of atropine in iritis.

forms have rather eclipsed others, and the first question which presents itself in any case of iritis, is whether it should be attributed to a syphilitic origin. Rheumatism is another dyscrasia which involves a special liability to iritis; and the disease also occurs in connection with over-work, exhaustion, and mental anxiety. It has been said by some writers that the syphilitic varieties of iritis present recognizable peculiarities, one of which is the deposit of lymph in lumps or nodules upon the surface of the iris; and there are, undoubtedly, certain cases in which such nodules are seen, in which they are simply syphilitic gummata, and in which the attendant inflammation is perhaps rather a consequence of their presence than a cause of their formation. Putting such cases aside, writers are by no means agreed touching the precise nature of the differences which distinguish syphilitic iritis from other forms; and as a matter of fact it would be very hard to define syphilitic iritis in any satisfactory manner. We cannot say that every case of iritis which occurs in a syphilitic person is syphilitic, unless we are prepared to affirm that syphilis affords an immunity from all the forms of iritis which may occur in non-syphilitic people. Practically speaking, the question is one of little moment, which has scarcely any bearing either upon prognosis or upon treatment.

Course.

In a few cases, in which iritis is originally of great severity, or in which it has from the first been aggravated by maltreatment, it displays a tendency to spread to the ciliary body and to the choroid, and to produce changes which are speedily destructive to vision, and which are followed by wasting of the eyeball. But in the great majority of instances the tendency of a first attack is towards resolution and ultimate recovery. If lymph has been poured out in large quantity, so as to form a continuous film over the surface of the crystalline lens, this film may be left as a semitransparent membrane, presenting, according to the degree of its opacity, more or less impediment to vision, and united to the pupillary margin either at its entire circumference or partially. When the effusion has been smaller in amount, and does not cover the pupil, it will nevertheless leave the pupillary margin adherent at certain points, and in such cases vision may be normal. If the adhesions occupy the greater part of the pupillary margin, so that they practically fix the greater part of the iris to the lens, they may be productive of no more inconvenience than such as attends the inability of the pupil to expand under a feeble illumination, and thus to compensate in some degree for a deficiency of light; but if there are only a few scattered points of adhesion, so that the pupil is generally mobile, and is constantly checked in its attempts at dilatation, such adhesions maintain a perpetual irritation, which is almost certain to excite a second attack of iritis. When this happens, still more of the membrane is tied down, and its nutrition becomes seriously affected. The iritis, under such circumstances, becomes recurrent, returning again and again at variable intervals, under the influence of any constitutional indisposition or any source of local irritation. In time it ties down the whole of the pupillary margin to the lens, so that the lens and iris together form an absolute and impermeable barrier which separates the anterior chamber from the deeper parts of the eye. This state is called 'exclusion' of the pupil.

Exclusion of the pupil. Its results.

In the natural condition, when the pupillary aperture is freely movable, its margin, when moderately contracted, lies in contact with the surface of the crystalline lens, but loses this contact, on account of the curvature of the lens surface, as soon as the pupil is dilated. There is, therefore, a free passage of fluid through the pupil; and exhalation from the anterior chamber appears to play an important part in regulating the quantity of fluid which is contained not only in that chamber itself, but also in the deeper parts of the eye. As soon as the pupil is excluded no fluid can pass into the anterior chamber from behind the iris; and consequently, as secretion behind the iris continues, accumulation must necessarily take place. Very soon after exclusion is complete the peripheral parts of the iris may be observed to become prominent, bulging forwards towards the cornea, and leaving the central parts comparatively depressed. The eyeball as a whole becomes distended and hard, the internal circulation is impeded, the vitreous passes into a liquid condition, the retina perishes from the combined effects of blood stasis and of compression, and the eye is destroyed as an organ of vision. When iritis leaves an adhesion of the pupil recurrence of the inflammation is to be expected; and recurrent iritis, unless the chain of morbid action can be broken, can scarcely have any other termination than eventual loss of sight.

Treatment of iritis.

It follows that the chief object to be kept in view, in the treatment of iritis, is to prevent the formation of adhesions, or to detach them if they have formed; and that in no case in which adhesions are left behind, even though all inflammation may have subsided, and although vision may be perfect, can

the result be considered satisfactory or complete. In order to bring about complete recovery it is necessary, first, to shelter the eye from all sources of irritation; secondly, to endeavour to procure full dilatation of the pupil by atropine; and, thirdly, if the pupil resists dilatation, to have recourse to mercury. Various details will offer themselves for consideration in different cases, but they will all be subordinate to the principles of action above laid down.

Avoidance of astringents.

Among the sources of irritation which are to be avoided the most formidable are the various astringents, such as lotions of nitrate of silver or of sulphate of zinc, which are sometimes sold as a cure for inflamed eyes by druggists, or which may be prescribed when an early stage of iritis is mistaken for conjunctivitis. Next to these would come the sources of irritation incidental to functional use and to movement in the world, such as exercise of the accommodation, and exposure to variations of light, variations of temperature, and atmospheric impurities. Whenever possible, a patient with iritis should abandon his occupation, should abstain almost entirely from reading, writing, or other visual employment of the sound eye, and should confine himself to a well-ventilated and dimly lighted apartment. When these precautions cannot be observed the affected eye should be covered by a compressive bandage, with sufficient padding to exclude variations of light and of temperature.

Use of atropine.

The solution of atropine should usually be of the strength of four grains of the neutral sulphate to an ounce of distilled water, and a drop of this solution should be applied to the lining membrane of the lower lid with a quill scoop or a dropping tube. It is a good rule to direct the application to be made three times a day, and each application to consist of three drops, with intervals of five minutes between them. A drop is applied, after five minutes another, after another five minutes a third; and this must be done three times a day. If a compressive bandage is worn, it must be laid aside for a quarter of an hour after each application of the atropine, in order that it may not absorb and remove the solution. In cases of only moderate severity, which are seen early, this treatment will often produce considerable dilatation of the pupil, with diminution of congestion and of uneasy sensations, within twenty-four hours, and complete dilatation of the pupil within forty-eight hours. When this is the course of events it is only necessary to maintain the dilatation, and the iritis will die out harmlessly, because, when the pupil is dilated, its margin is no longer in contact with the lens, and lymph, even if it should be poured out, cannot form adhesions, but will be diffused through the aqueous humour. Apart from this, the atropine, probably by virtue of its influence upon the vaso-motor nerves, seems to be distinctly antiphlogistic in its action. When all congestion has subsided, and when the absorption of any turbidity in the aqueous humour has restored the iris to its natural colour and lustre, the atropine may be laid aside; but the eye must be carefully watched for a few days, and especially when it is again taken into use, in order that the slighest appearance of relapse or of returning irritation may be met by a renewed application of the remedy.

Under three sets of circumstances – first, when the action of atropine, after twenty-four hours, fails to produce any marked abatement of the symptoms; secondly, when, after forty-eight hours, although the symptoms have abated, the pupil is not circular, but is rendered irregular by broad bands of adhesion; thirdly, when the iritis is already of some duration before it is submitted to treatment—it is necessary to have recourse to mercury, and to

obtain its effect with as little delay as possible. Every practitioner will choose his own preparation and mode of administration, but perhaps the form most generally applicable is blue pill, in doses of two or three grains three times a day, and in combination with a small quantity (say a quarter of a grain) of opium. As soon as the faintest mercurial line appears upon the gums the dose should be greatly diminished, so that this slight effect may be maintained, but not exceeded; and under its influence we often see lymph absorbed, and adhesions disappear, with great rapidity. I am accustomed to take resistance to atropine as the sole indication for mercury in iritis (such resistance being a matter of course when the inflammation has remained unchecked for two or three days, and adhesions have had time to become firm); and I do not regard either the need of mercury, or rapid improvement when it is administered, as any certain evidence of syphilis. Neither does it follow that the iritis of a syphilitic person will resist atropine and will require mercury, even although the use of the mineral may be indicated for some other syphilitic manifestation. As regards the eye only, the mercury must be continued as long as improvement takes place under its use, and then, together with the atropine, it must be discontinued carefully and watchfully.

Complications of iritis.

Iritis may be complicated, or attended, with an unusual degree of pain, or with an unusual degree of vascular excitement, and both of these conditions may interfere with the action of atropine, without demanding that of mercury. When there is much conjunctival congestion, together with elevation of local temperature and fulness of the temporal vessels, two or three leeches should be applied round the margin of the orbit, and their bites suffered to bleed freely. In the greater number of cases the morbid sensations hardly amount to anything more than uneasiness, and when actual pain is suffered it must be relieved or subdued before healthy reparative action can be expected. Pain may be tensive, due to the stretching of the ocular tunics by increased secretion (a form that is scarcely met with excepting in serous iritis); or it may be an expression of exalted nervous sensibility. The former variety will be considered presently; the latter calls for the unstinted employment of anodynes. Especially when pain shoots along the various branches of the first division of the fifth nerve on the affected side, it is generally desirable to have recourse to the subcutaneous injection of morphia, in such doses and at such intervals as may afford immunity from suffering, while the atropine, and if necessary the mercury also, are employed in the manner which has been described.

Duboisin.

There are a few cases, very rare indeed but still occasionally met with, in which atropine, either from the first or after a few applications, acts upon the eye as a local irritant, and produces surface inflammation which is apt to extend to the skin around the palpebral fissure. When this happens, the atropine should be replaced by a similar solution of duboisin, an agent equally powerful in dilating the pupil, and which appears to be free from this irritating tendency. Duboisin is an alkaloid yielded by an Australian plant, the Duboisia Myoporoides, and is chemically identical with hyoscyamin. For the atropine irritation itself, when it affects the external skin, a compress wetted with a weak lead lotion is the most effectual remedy.

Remaining adhesions.

When the subsidence of iritis leaves an adhesion which has resisted treatment, the use of atropine or duboisin and of mercury must be cautiously continued for a time, in the hope that the former may mechanically stretch and break the new tissue, while the latter causes it to undergo disintegration

and absorption. If no declared effect is produced within a month, the medicines should generally be discontinued, and the adhesion regarded as permanent. The patient should be forewarned of his liability to another attack of inflammation, and should be cautioned to seek advice immediately if such an event should occur. In a certain small proportion of cases no harm will follow, but in others the patient remains conscious of the adhesion, which produces sensations of dragging or discomfort, and in the great majority a second attack of iritis will sooner or later occur. When this happens it must be treated in the ordinary way, with atropine, before having recourse to mercury; for, although the existing adhesions will forbid complete dilatation of the pupil, the atropine will nevertheless exert considerable antiphlogistic action. After the second attack has subsided, means should be taken without delay to destroy the injurious effect of the adhesions, for recurrence is then no longer doubtful, and if the adhesions are left the eye will almost certainly be disorganised by repeated inflammation. Two methods offer themselves—either to break the continuity of the iris, and to prevent closure of the pupil, by a sufficient iridectomy, or to detach the adhesions by traction with a hook or forceps introduced into the anterior chamber. Of these methods the former is generally to be preferred, as being the more effectual and the less dangerous of the two, the detachment by traction being open to the objection that the adhesion may re-unite, and that the instrument employed or the traction exercised may injure the capsule of the lens and produce traumatic cataract. After the performance of an iridectomy it rarely happens that iritis will occur again; and its occurrence would be comparatively harmless, on account of the large and free opening which would exist between the anterior and the posterior chamber. The rule of practice, therefore, would be to perform an iridectomy in every case in which adhesions left by iritis were sources of discomfort to the patient, or in which the patient was about to travel to remote places, where he might be unable to procure surgical aid, or in which the adhesions had already produced a second attack of inflammation. If the natural pupil is free from lymph and the vision good, the iridectomy may be placed under the shelter of the upper lid, where it will be out of sight; but if the pupil is at all covered it is best to remove a piece of iris which is non-adherent, and which will therefore leave a clear aperture for visual purposes. If the piece removed is adherent it will often leave opaque lymph or pigment upon the capsule of the lens.

Iridectomy.

When only two attacks of iritis have occurred there is seldom any difficulty in performing iridectomy in an effectual manner; but after repeated attacks the operation, although still indicated as the best or even the only resource, may be very difficult of accomplishment. The stroma of the iris is often so weakened that it will tear under the traction of the forceps, so that no large opening can be made, and the inflammation has often spread by continuity to the choroid, and has occasioned effusions which prevent the restoration of useful vision.

Serous iritis.

The other chief variety of iritis—the serous—is comparatively of rare occurrence, and is seldom met with except in persons of disordered health, and especially, I think, in cases of renal disease. It differs from the plastic in the morbid product being a turbid liquid instead of lymph; and this liquid, while it obscures the iris and renders it dull, and while it overfills and distends the eyeball, has no tendency to the formation of adhesions. In general appearance the eye resembles one which is suffering from iritis of the ordinary kind; but the pupil is usually quite insensible to the action of

atropine (probably because the overfilled state of the eye prevents absorption), and the plane of the iris is in some degree pushed backwards, so that the anterior chamber seems to be deeper than usual. At the same time the eyeball will be rendered very hard by tension, the sight will be greatly affected by the compression of the retina, and a good deal of dull stretching pain is usually experienced. The first thing to be done in such a case is to diminish tension, by repeated paracentesis if the case is seen early and can be closely watched, by iridectomy under the opposite conditions. As soon as the fluid is evacuated the pupil will respond readily to atropine, and uninterrupted recovery will usually take place.

Iridochoroiditis.

When plastic iritis, either in the first or in any subsequent attack, extends to the choroid, the severity and the danger of the case are much increased, and the inflammation frequently terminates in wasting of the globe and loss of sight. The chief evidence of extension to the choroid would be furnished by tenderness of the ciliary region under gentle pressure, by an impairment of vision in excess of that for which the iritis would account, and by immobility of the pupil under atropine; often, if the cornea and aqueous humour retain sufficient transparency, by the appearance of visible blood-vessels in the iris itself. The treatment under such circumstances must be mainly mercurial, combined with careful attention to the diet and general condition of the patient. Pain should be subdued by anodynes, paracentesis of the anterior chamber should be performed, and the aqueous humour evacuated twice daily. Under the most favourable circumstances nothing better than partial recovery can be expected, with a closed pupil and often with an opaque lens. A large iridectomy should be performed as soon as the inflammation has subsided, and the lens, if opaque, should be extracted. In most cases this operation will be followed by some degree of fresh inflammation, which will usually close the pupil left by the iridectomy, and will leave in the axis of vision a tough membrane consisting of iris and lens-capsule, united by effused lymph. When a sufficient time has elapsed, and the eye is again quiet, some degree of vision may often be restored by cutting out a large portion of this tough membrane and removing it entirely, so as to leave a good central pupil. For this purpose a large incision should be made into the anterior chamber with an iridectomy-knife, and through this incision an appropriate pair of scissors may be introduced and made to pierce the membrane with one blade, so that they may cut out a piece of such size as may be desired.

Diseases of the crystalline lens.

The structure next to the iris in point of anatomical position is the crystalline lens, which is naturally of brilliant transparency, but which is liable to undergo perversions of nutrition which render it more or less turbid or opaque, and which constitute the various forms of cataract. Of these forms the most noticeable are the congenital, the laminar, and the senile.

Cataract.

Congenital cataract.

In the obviously congenital forms of cataract it becomes apparent, soon after birth, that the pupils of the infant's eyes are not of their usual blackness, but of a bluish-white or milky appearance; and dilatation by atropine shows that this appearance extends over the whole of the surface of the lens. When the infant is old enough it will be found to follow a lighted candle with its eyes, but to have no vision of conspicuous objects; and in this condition it is very important that an operation should be performed early, because otherwise the external muscles of the eyes, not being guided in their movements by the sense of sight, will never acquire the power of definite fixation, and the globes will permanently oscillate in the curious rhythmical fashion which

has received the name of nystagmus. The operation should not be delayed beyond the third or fourth month, and at this age the best method of proceeding is by solution; that is to say, by breaking up the lens a little at a time, and leaving it to be dissolved or absorbed by the action of the aqueous humour. For this purpose, the pupil being first fully dilated by atropine, a very fine cataract needle should be passed through the cornea to the centre of the pupil, where it should make a small puncture or slit in the anterior capsule of the lens, and should be immediately withdrawn. No force should be employed, lest the lens should be dislocated, and the needle-point should be used very sparingly, lest too much lens-tissue should be disturbed, and the eye oppressed by more than it can readily absorb. The dilatation of the pupil should be maintained, and on the second or third day a fragment of lens-matter may be seen protruding through the wound in the capsule. As the fragment is absorbed more will come forward in a similar manner, and as long as this process continues, and there is no iritis, there is no cause for further interference. But in most cases the first wound in the capsule will close, or at all events the progressive absorption of the lens will be arrested, and then it will be necessary to use the needle again, somewhat more freely than on the first occasion. A third or even a fourth operation may be required; but eventually the lens will be completely absorbed; and, if the punctures have been made in the centre of the capsule, this structure will undergo retraction, and will leave a central clear space behind the pupil, through which good vision may be obtained.

Removal by solution.

Iritis during solution.

The eyes of infants are extremely tolerant of this procedure, provided it be executed with due care; but if too much of the lens is broken up on any one occasion, or if dilatation of the pupil is neglected, so that its margin comes into contact with the lens-matter, iritis is apt to be excited, in which case the whole of the lens should be evacuated as speedily as possible, by suction, in the manner presently to be mentioned. In order to avoid such a necessity the surgeon should always be sure, before treatment is commenced, that the mother or nurse understands the use of the atropine solution, and can be trusted to apply it effectually.

Pyramidal or punctated cataract.

A form of cataract which is not congenital, and which consists essentially of a deposit of lymph on the anterior capsule, is sometimes called 'pyramidal' or 'punctated,' according to its appearance. It is produced by the purulent ophthalmia of infancy, during which, if the cornea is perforated, the lens falls forward into contact with Descemet's membrane, and is pushed back again, carrying with it a dot of lymph, as the aqueous chamber is restored. If the lymph-deposit is very small it remains flat; but if it is abundant it is apt to be stretched out before the cornea and lens separate, and to remain attached to the latter as a little pyramid, the apex of which projects through the pupil. Upon the lymph thus deposited some saline matter from the aqueous humour is thrown down, giving a chalky whiteness to the ultimate formation; and then, as the cornea recovers its transparency, either a minute white dot or a small white pyramid will be seen in the centre of the pupillary space. Such cataracts are so small that the patient would usually be able to see round them without dilatation of the pupil; and any impairment of sight with which they may be associated is usually due rather to haziness of the cornea than to opacity in the lens. In consequence of the former, such cataracts are often complicated with nystagmus. In any case in which such a proceeding seemed advisable, the lenses could be removed by suction or solution; but improvement of sight would rarely follow.

In 'laminar' cataract, the opacity, although sufficiently dense to interfere with even the beginning of school work, is seldom dense enough to be conspicuous through undilated pupils, or to cause anything approaching to actual blindness; and hence, although possibly a congenital affection, it is seldom discovered until early childhood is passed, and frequently not until the patient had been unjustly punished for supposed obstinacy or stupidity, which in reality would be nothing but want of sight. Whenever a child's first teachers complain of it in this manner the surgeon should dilate the pupils and carefully examine the eyes. The colour of laminar cataract is rather grey or nebulous than white, and the turbidity is limited to a stratum of lens-matter which surrounds a transparent nucleus, and is itself surrounded by transparent cortical substance, so that it occupies the position of the dark line A in the annexed diagram. The size and thickness of the cloudy stratum are variable, so that some laminar cataracts are much smaller than others in superficial extent. They differ also in this, that in some the transparent peripheral portion of the lens is absolutely transparent, while in others it is broken by opaque dots or striæ. In the former cases the periphery may be expected to retain its transparency, in the latter it will in time become turbid throughout. On these physical differences depend great differences in the treatment which should be pursued; for, if the periphery around the opaque lamina is broad and transparent, it is obvious that good vision through this portion of the lens may be obtained by dilatation of the pupil, or by making an artificial pupil in front of the transparent portion; while, if the transparent annulus is very narrow, or if it is itself threatened with opacity, the vision obtained by the above methods will either be imperfect in its degree or only temporary in its duration, and removal of the lens, which will eventually be necessary, may properly be undertaken in the first instance. For the determination of these questions the surgeon should examine the lenses with the ophthalmoscopic mirror and with focal illumination in a way which will be described when the diagnosis of senile cataract is being considered.

Laminar cataract.

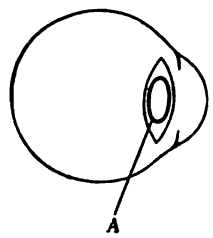


Fig. 336. Diagram to illustrate the position of laminar cataract.

In a large proportion of the cases of laminar cataract, the patient will be found to have defective teeth, and especially a notched and irregular state of the permanent incisors; and an inquiry into the history will often show that the first dentition was attended by convulsions. Mr. Hutchinson has advanced the ingenious hypothesis that the laminar cataract is associated with the convulsions, and that the defective teeth are a consequence of the administration of mercury whilst the convulsions were occurring, either under medical direction or in the form of Stedman's powders or other nostrum. He states that he has seen instances in which convulsions were not treated with mercury, and in which the patient grew up with laminar cataract, but with perfect teeth. If we consider that the teeth and the lenses are alike derived from epithelial matrices, it will appear probable that the development of both may be disturbed by a common cause, rather than by the coincident operation of two causes of entirely different character.

Relation to convulsions and to mercury.

The removal of laminar cataract may often be successfully accomplished by solution; but, as the patients are mostly children, whom it is more or less difficult to restrain, the risks of inflammation or of injury during the oftentimes lengthy process are much greater in them than in infants, and a

Removal by suction.

less protracted treatment is exceedingly desirable. This is afforded by the old Persian method of suction, which, with improved appliances, has been introduced into modern practice by Mr. Pridgin Teale, of Leeds. The principle of suction is that the whole of the lens should be thoroughly broken up and cut to pieces with needles at a single sitting; and that after the lapse of a few days, when the disorganised mass has been rendered pulpy by the aqueous humour, and before its presence has excited irritation, it should be sucked out of the eye through an appropriate tube introduced through a small corneal opening. When this is successfully accomplished a cataract which would have required months for complete absorption may be entirely removed in the course of a single week.

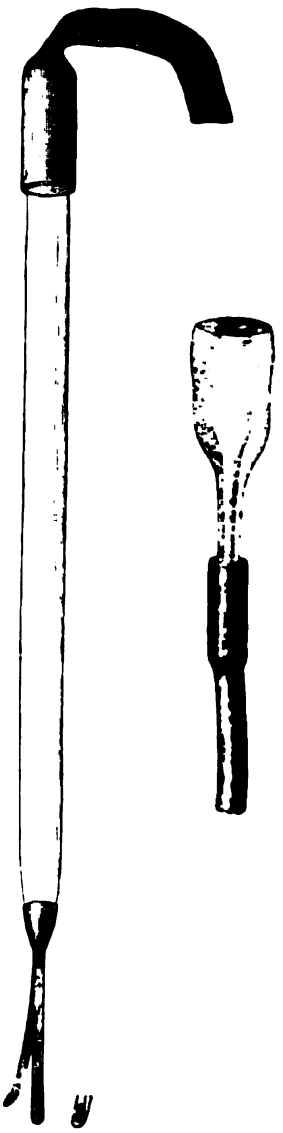


Fig. 337. Curette and mouthpiece for the removal of cataract by suction.

For the successful performance of suction it is necessary that the original cutting up, or 'discission' of the lens, should be complete, and it is highly desirable that the vitreous body should not be penetrated in the process. The plan which I pursue is to obtain the widest possible dilatation of the pupil, and then to introduce two needles at once, one on the nasal, the other on the temporal side of the cornea; each needle being used for the half of the lens which is farthest from its wound of entrance. Each needle is made to cut through its portion of lens by a succession of regular, closely set, parallel strokes, reaching from margin to margin, and carried to a depth corresponding with the thickness of the lens-tissue in each place. Nothing but practice can enable the operator to accomplish this as completely as he would desire. Dilatation of the pupil must be maintained, and in the course of a day or two the broken lens-matter will fill the anterior chamber, in a condition much resembling a white flocculent precipitate. It may then be evacuated by suction, an operation which is performed by means of a small slightly curved tubular curette, semicircular in section, smooth and rounded at its free extremity, and provided with a small round or oval opening, near this extremity, in its flat or concave surface. The curette has been attached to more than one form of exhausting syringe, but its action is most effectual and most delicate when it is fixed to a glass tube which serves as a handle, and which is connected by an india-rubber tube with a glass mouthpiece, thus forming the instrument of which the extremities, the intervening piece of tube being omitted, are shown in the figure. The curette itself may be of various sizes, and its opening may be large enough to admit quite large fragments, and should be notched transversely, as shown in the small figure, to prevent it from being closed by contact with the cornea. It should be introduced into the eye through a small incision near the corneal margin.

with its flat or perforated side towards the inner surface of the cornea; and it should be made to dip down into the lenticular space. When thus placed, gentle mouth-suction will draw all the lens-matter through the aperture and into the glass tube; and any stray fragment may be followed until the aperture is beneath it, when it must needs fall into the stream. If the tube appears to be obstructed it may be withdrawn from the eye, blown clear, and re-introduced; and throughout the operation the course of the fragments should be carefully watched, and the suction regulated with a nicety which no mechanical substitute for the mouth can imitate. When all turbid matter is removed the eye should be closed by a compressive bandage, and atropine should be applied daily until recovery is complete.

Complications.

If the preliminary discission of the lens has been in any way faultily performed, the course of events may be less smooth. If the posterior portion of the lens has been left untouched by the needles it may remain transparent, and hence invisible, until after the anterior or broken portion has been removed. In such a case the suction may appear to be complete, and the pupil may look clear and black at the time of operation; but yet, a day or two later, fresh portions of turbid lens-matter may present themselves and may not only interfere with vision, but may even produce irritation. If the quantity thus left in the eye is insignificant, and if no inflammatory symptoms appear, it will be sufficient to keep the pupil dilated and to wait for absorption; but if the quantity is large, or if there should be any evidence of threatening or commencing iritis, suction should be repeated without delay. If the needles have passed through the lens, so as to pierce the hyaloid membrane and to permit vitreous humour to mingle with the fragments, the latter will be less readily softened than by the aqueous alone, and some amount of vitreous will be removed by the suction curette, or may afterwards escape through the corneal wound. In early operations it is better to do too little than too much, and a second recourse to suction is preferable to an admixture of vitreous with the lens-fragments.

Risks.

Under ordinary conditions the removal of laminar cataract by suction is a very safe operation; but in a few instances it is followed by severe plastic iritis, and it may even lead to suppuration of the eyeball. The dangers attending it may be looked upon as arising from the circumstance that eyes which are the subjects of laminar cataract are often in other respects feeble and imperfectly developed organs, prone to destructive changes under slight provocation; and the operation must be very cautiously undertaken where other evidences of imperfection are manifest. If there is congenital displacement of the lenses, or nystagmus, or strabismus, or if the eyeballs are small and generally malformed, the treatment of laminar cataract must be undertaken with some hesitation, and must be made the subject of a very guarded prognosis. After discission or suction has been practised, if any symptoms of acute inflammation should show themselves, an iridectomy should be performed without delay; all remaining lens-matter and all inflammatory products should, as far as possible, be evacuated; a leech or two should be applied near the margin of the orbit, and cold compresses over the lids; rest in bed should be enforced, and pain should be subdued by anodynes. Under such treatment it will often happen that a favourable or partially favourable issue may be obtained; but, if suppuration of the eyeball should be plainly impending, it is generally advisable to save pain by the early performance of enucleation. It is obvious, supposing laminar cataract to affect both eyes, that they should never be operated upon together.

Senile cataract.

By senile cataract is meant an impairment of the transparency of the crystalline lens, which commences in persons past the middle period of life (or, in rare instances, in those who are comparatively young), and which appears to depend upon a local failure of nutrition. The central parts of the healthy lens are of somewhat firmer texture than the superficial; and the gradual hardening of the whole structure which occurs as life advances is more marked in the former than in the latter. In the lens of any aged person, whether it is transparent or opaque, a variable depth of the outer laminæ will be soft, and readily removed by the fingers; while a variable bulk of the central laminæ will retain a marked degree of firmness and coherence. The former portion is termed the cortex, or the cortical substance, the latter the nucleus; and they are readily to be distinguished from each other, although no exact line of demarcation can be drawn between them. Senile cataract appears in two principal forms, the nuclear or hard cataract in which the natural hardening or drying process is exaggerated, and in which there is a large, hard or almost horny nucleus, surrounded by a thin layer of transparent cortex; and the cortical or soft cataract, in which the nucleus may remain transparent long after the cortex is invaded by opaque striæ, which appear to be lines of fatty degeneration, and which, as they increase and coalesce, tend to envelope the hard nucleus in a layer of softened and degenerated cortical substance, which may even break down into complete liquefaction and may become the seat of calcareous deposits. But both the forms of senile cataract differ from those which are congenital, or which occur in early life, in this, that both, whatever may be the state of their outer layers, contain a hard nucleus which does not undergo softening, which cannot be broken up with needles, and which cannot be absorbed within the eye; so that for the restoration of vision, the nucleus must be removed or 'extracted' entire, through an opening sufficiently large to afford it a free passage.

Diagnosis of senile cataract.

In childhood and early life, when the pupil is naturally of a clear, bright black, any milkiness or turbidity of the crystalline lens can be ascertained by simple inspection, and cataract can hardly be overlooked if there is any complaint of defective vision. There is only one condition at all liable to be mistaken for it, and that is the growth of a malignant tumour in the vitreous chamber, when, although the pupil may be of a whitish or yellowish colour, the diagnosis would generally be rendered easy by the hardness of the eyeball produced by the increase in the quantity of its contents, and by the presence of a greater degree of blindness than cataract would explain. But in elderly people, in whom there is always a certain degree of amber colouration of the lens, and in whom, from various conditions, more light is often reflected from the fundus than in young people, the pupils are seldom or never of a bright black, and they often present a most deceptive resemblance to the colour of commencing cataract. At the same time, persons in the decline of life are subject to other affections, such as nerve-atrophy and chronic glaucoma, which may in some degree imitate cataractous blindness; and hence the diagnosis, while it is of the highest importance, is not altogether free from difficulty. In former times, indeed, it was very difficult, and there can be little doubt that even highly skilled persons were often led to erroneous conclusions with regard to it. Of late years the difficulties have been in great measure removed by the employment of the ophthalmoscope.

By the ophthalmoscope.

For this purpose it is not necessary to use the instrument in such a manner as to obtain a view of the details of the background of the eye, but

only so as to illuminate the area of the pupil. The observer takes the mirror alone, places its edge in contact with the margin of his orbit, so that he can look through the sight-hole, and then directs the light from a suitably-placed lamp fully into the eye of the patient, which, if the pupil is not artificially dilated, should be directed somewhat inwards towards the nose. Under such circumstances, if the media of the patient's eye are transparent, the circular area of the pupil will appear as a field of uniform and unbroken illumination, the brighter the larger it is, and more or less whitish, reddish, or yellowish in colour, according to the part of the fundus which is opposite to the observer, and to the degree of pigmentation of the fundus. If, on the contrary, the media are anywhere opaque, the opacities will intercept the return of the light, and will appear as black lines or patches in the illuminated field. They may be situated in the cornea, in the crystalline lens, or in the vitreous body, but in the cornea they will be readily discoverable by superficial examination, and in the vitreous they will in almost every instance be movable, whisking about in response to quick movements of the eye itself, and slowly sinking by gravitation when it is at rest. In the lens they are of two chief classes, which may be found either singly or in combination, namely, the wedge-shaped striæ of cortical cataract, which have their bases towards the periphery and their points directed towards the centre of the pupil; and the central irregular cloud of nuclear cataract.

By focal illumination.

When opacities in the lens are discovered by the ophthalmoscopic mirror they should next be studied by focal illumination, that is to say, by concentrating the light of a lamp upon the pupil with a lens, while the illuminated surface is magnified for examination by another. The annexed figure shows the relations of the lamp and lenses to the eye of the patient; and by focal illumination the opacities will no longer appear as dark objects, but will be shown in their proper colours. The opacity of nuclear cataract will generally be of a dark yellowish-brown or London fog colour; and the striæ of cortical cataract will be lines of yellowish white. At the same time the depth of the opacities may be discovered, so that it becomes easy to say about what thickness of transparent cortex covers a cloudy nucleus, and whether cortical striæ are chiefly in the anterior or in the posterior portion of the lens.



FIG. 338. Focal illumination for detection of cataract.

Extraction must be deferred until maturity.

Extraction of senile cataract, which is practically the only remedy for the blindness which it produces, should be deferred, unless for very cogent reasons, until the cataract is mature; that is to say, until the degeneration has so far involved the cortical layers that they have lost their natural adhesion to the capsule of the lens, and will slip out easily when that

structure is divided. If extraction is prematurely practised the nucleus may leave behind a quantity of cortical substance, invisible by reason of its transparency at the actual time of operation, but which on the following day will be seen lying in the pupil as an opaque and swollen mass, which not seldom excites dangerous or destructive inflammation. A mature cortical cataract is either uniformly whitish or has a striated appearance, like that of spermaceti; and a mature nuclear cataract may retain its pea-soup tint; but the best test of maturity is that the iris, under lateral illumination, casts no crescentic shadow, or only a very narrow one, upon the opaque surface on the side from which the light comes. The presence of the shadow evidently implies the existence of a space filled with transparent matter between the margin of the pupil and the opaque surface behind it. If the opacity appears to touch the pupillary margin, so that there is no room for a shadow between them, then maturity is complete, and nothing can be gained by delaying the operation. Under some circumstances, and especially when the fear of blindness or the actual impairment of vision is either a source of great mental depression or a cause of physical privation by producing incapacity to labour, it may be advisable to operate before cataract is mature, even although the risk of failure is thereby somewhat increased.

Operation of extraction.

The operation of extraction is one of great delicacy, which, after having been performed in the same way, almost without variation, for about a century, has of late years been 'modified' in so many ways, and by so many different operators, that it would be impossible, within the limits here available, even to enumerate the changes which have been suggested. In the old method, which is now usually called 'flap extraction,' the surgeon cuts through about half the circumference of the cornea, immediately in front of its attachment to the sclerotic, thus forming a semicircular 'flap.' Through the wound thus made, and through the pupil, the anterior capsule of the lens was freely lacerated by an appropriate needle, the lens itself was expelled by well-directed pressure, and the lids were closed and secured. This method, when it was successful, left nothing to be desired; but it was followed, in about 20 per cent. of the eyes operated upon, by destructive changes, which commenced, in about equal proportions, in iritis due to the stretching of the pupil, and in sloughing of the cornea due to its extensive severance from the sources of its nutrition. Von Graefe was the first to suggest that the excision of a segment of the iris would prevent the stretching of the pupil by the lens, and would diminish the tendency to iritis, and when this suggestion was carried into effect it was found that the iridectomy rendered it possible to extract through a smaller external wound than had formerly been required, and thus to diminish the risks of corneal sloughing. Von Graefe worked very sedulously during several years at the endeavour to exclude, one by one, the chief sources of danger by which extraction was beset; and he arrived at last at the point of losing only four eyes out of a hundred operations. Since his death a few improvements of detail have been introduced, but as far as principles and broad outlines are concerned he had covered the ground; and the operations of a few surgeons who have since departed from his methods, either returning to a modification of flap extraction or making some form of transverse section of the cornea, do not appear likely to find favour with any but those who have introduced them.

Modified linear extraction.

The general idea of modified linear extraction is that the preliminary incision should be no longer than is required for the exit of the lens, that it should lie entirely in a portion of a larger circle than that of the cornea, that

it should be in a tissue which will heal readily, and that the escape of the lens should be facilitated by the excision of a portion of the iris. At the same time the surgeon must be careful to avoid the ciliary region, a wound of which would be likely to produce sympathetic ophthalmia.



Fig. 839. Linear knife for extraction of cataract.

For the fulfilment of these indications the extremities of the section should lie just behind the true corneal tissue, in a line parallel to, and two millimètres below, a horizontal line touching the upper margin of the cornea. The patient being recumbent, and fully etherised, the surgeon separates the lids by a spring speculum. A linear knife (Fig. 839), which should have a blade thirty millimètres long, two broad, and as thin as is compatible with the necessary rigidity, is held in the right hand for the right eye, and in the left hand for the left, the operator standing behind the head of the patient. The eyeball is secured by fixation forceps, and the point of the knife is then entered, its cutting edge upwards, just behind the margin of the cornea, as at A, in Fig 840. The direction of the thrust is towards the centre of the eyeball, until the anterior chamber is penetrated, when the point is turned so as to descend, in a direction parallel with the plane of the iris, to about the position of B. When this is reached the handle is depressed, turning on the back of the blade in the incision, until the point is brought to C on the same horizontal line as the puncture. When this is reached the handle must be inclined somewhat backwards, and the point pushed on with a quick movement, so that it may transfix both sclerotic and conjunctiva at its place of first impact. The flat surfaces of the blade should now be parallel with the plane of the iris. The fixation instrument should be laid aside, the edge of the knife turned very slightly forwards, and the incision completed by a succession of gentle drawing cuts, which should bring its centre to coincide with the junction of the cornea and sclerotic, and the last of which should be made with especial care.

The iridectomy.

The next step is the iridectomy, which has not for its object the formation of a large coloboma, but only to destroy the resistance of the sphincter of the pupil to the passage of the lens. A pair of delicate forceps, shown open in the figure, Fig. 842, and with their minute teeth, both open and closed, at A, B, and C, are introduced closed through the incision, and suffered to expand a little when they approach the pupillary margin of the iris, which will then rise between them, and may be seized, gently drawn out, and cut off close to the forceps blades by one stroke of a pair of scissors. If this is properly done the angles formed between the terminations of the incision and the margin of the pupil should be visible within the anterior chamber, as at A and B, in Fig. 841; but if the iris is dragged out and cut close to the

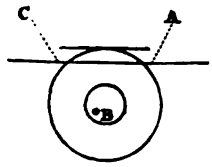


Fig. 840. Diagram showing the incision for linear extraction.

angles of the external wound, the appearance shown in the second figure will be presented, and portions of iris will often be left incarcerated at the angles, where they may excite great subsequent irritation. The iridectomy completed, the operator lacerates or freely divides the capsule of the lens, using for this purpose a needle slightly curved at its extremity, or the 'fleam-shaped' cystitome of Von Graefe, or the forceps cystitome of De Wecker, by which a piece of capsule may be brought out of the eye. In lacerating the capsule it is essential to divide it very freely, and to use the selected instrument very gently, as otherwise the lens itself might be dislocated into the vitreous. When this step is completed, it is often desirable to remove the spring speculum from between the lids, and to replace it by an elevator which acts upon the upper lids only. The best instrument for this purpose is the invention of Dr. Noyes, of New York, and consists of a double loop of wire, set in an ordinary ivory handle. An assistant depresses the lower lid by drawing it down towards the malar bone; and the operator proceeds to expel the lens from the eye by gentle and well-directed pressure. For this purpose the back of a small vulcanite spoon is applied just below the cornea, where its pressure should first be directed backwards, so as to turn the upper border of the lens forwards towards the incision, then upwards, so as gradually to force it out through the opening. As soon as the nucleus has escaped the lid-elevator may be removed, and gentle friction exercised through the closed lid, by which any remaining cortical fragments will be gathered together in the pupillary space, from whence they may be extruded by carefully-regulated pressure. As soon as everything is removed the eye may be finally closed and bandaged.

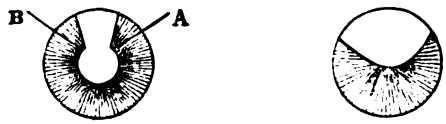


FIG. 341. Diagram of the correct and faulty sections of the iris.

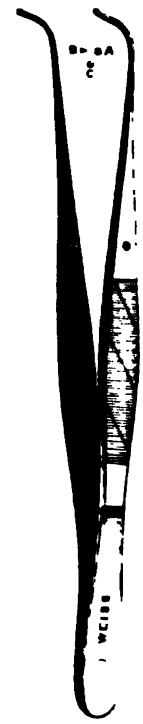


FIG. 342. Iridectomy forceps.

Loss of vitreous.

If vitreous humour should escape before the lens the latter must be at once removed from the eye by a scoop or hook; and if vitreous should follow the lens the eye must be closed as quickly as possible, even though a certain amount of cortex may be left behind.

Hæmorrhage.

Very rarely, the exit of the lens is followed by intraocular hæmorrhage, due to the rupture of a choroidal vessel suddenly deprived of support. When this happens there is no hope of preserving sight, and the distended eyeball usually becomes the seat of painful and tedious suppuration. It is better to prevent this, whenever blood or coagulum is seen issuing from the wound, by performing enucleation while the patient is still under the influence of an anæsthetic. Of course the trivial bleeding which may arise from the cut iris must not be confounded with that from a deeper source.

Natural healing.

If the whole of the cataract has been removed without mishap, and if the reparative powers of the patient are even moderately good, the external wound will heal quickly. The patient may usually rise from bed on the second or third day, and may often lay aside the bandage in the daytime

after the fourth or fifth day, wearing a shade, and replacing the bandage before assuming a recumbent posture. As irritation subsides the light may be gradually admitted; but the eye should not be brought into use for a few weeks, so that the cicatrix may become firmly consolidated before it is exposed to the traction of the recti muscles.

Suppurative inflammation.

In cases which proceed less favourably there are two chief dangers to be dreaded. In some patients the injury is followed by acute iritis, with a tendency to suppuration, or by sloughing of the cornea, and either of these conditions commonly leads to complete suppuration of the eyeball. They are ushered in, usually on the second day, by redness and swelling of the upper lid, with swelling of the conjunctiva and slight puriform discharge; and these conditions call for the administration of quinine, ammonia, and alcohol, for the application of firm pressure, alternated with hot fomentations, and for the use of a lotion containing five grains of hydrochlorate of quinine to the ounce of distilled water, to be applied to the conjunctiva of the lower lid by a quill. By such treatment it is sometimes possible to save an only partially damaged eye; but if the suppuration and swelling increase, and the whole cornea becomes opaque, all hope must be given up, and free incisions should be made through the sclerotic between the recti muscles, to diminish pain and tension, and to permit the escape of pus and sloughs.

Plastic inflammation.

Such instances are fortunately much less common than they were when flap extraction was practised; but a moderately large proportion of patients still suffer from a chronic iritis of plastic character, which is often excited by the remains of cortical substance left within the eye, and which in severe cases may produce a good deal of very obstinate neuralgia, and may even terminate in wasting of the globe and loss of sight. In mild cases it may do no further mischief than to leave the pupillary space obstructed by bands or membranes of blended capsule and lymph, which may require to be torn by cataract-needles, or even cut out and removed by scissors and forceps, in order to afford useful vision. The treatment of this chronic iritis must be by atropine, an occasional leech at the margin of the temple, the seclusion of the eye from all irritants, the control of pain by morphia or other anodynes, and the use of such constitutional remedies as circumstances may require.

Extraction of immature cataract.

When circumstances render it desirable to extract cataract at a comparatively early period, before full maturity has been attained, this may be most safely done by the performance of iridectomy as a preliminary operation, to be followed by extraction in a month or six weeks. The cut edges of the iris will then have soundly healed before the final step is taken; and they will be much less liable to suffer irritation from retained cortex than they would be in the freshly cut condition.

Cataract glasses.

An eye from which a cataract has been extracted, unless it was originally very highly myopic, will have no defined vision until the optical power of the natural lens is supplied by an artificial one. Moreover, as it is the elasticity of the natural lens which allows the eye to be adjusted for different distances, and as this quality is wanting in the artificial one, it must be supplied by the use of different powers. As a general rule, an eye which has been operated upon for cataract will require a convex lens of from 15 to 18 dioptrics (2 to 2½ inches focal length) for reading, and of 11 to 18 dioptrics (8 to 8½ inches focal length) for distance.

Diseases posterior to the lens

Excepting large hæmorrhage into the vitreous body, and the growth of intraocular tumours, both of which may produce a deep-seated change of

require the ophthalmoscope.

colour discernible by focal illumination, the diseases of the parts of the eye behind the crystalline lens were formerly concealed from observation; and, until many of them were revealed by the invention of the ophthalmoscope, they were all included, when they produced impairment of sight, under the general term 'amblyopia;' and when they produced blindness under the general term 'amaurosis.' The impossibility of seeing into the deeper chambers of the eye without optical assistance depends upon the fact that the rays of light can only return from an eye along the same track by which they enter it; and hence the eye of an observer cannot be so placed as to receive the returning rays without his head at the same time intercepting the entering rays, and throwing what he wishes to see into darkness. The ophthalmoscope is a mirror with a central perforation, and it acts by reflecting the light of a lamp, which is placed at the side and a little behind the head of the patient, into the eye under examination. The returning light then comes back to the mirror, and some of it passes through the central perforation into the eye of the observer, which is so placed as to receive it.

Methods of using the ophthalmoscope.

There are two methods of using the ophthalmoscope—the direct and the indirect. The latter affords the best general view of the interior of the eye; the former is more especially adapted for the minute examination of details.

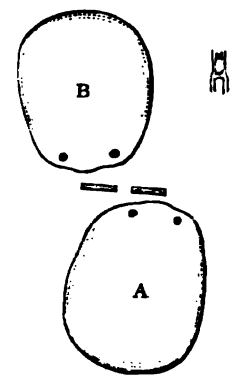


FIG. 342. Diagram of direct ophthalmoscopic examination.

Direct method.

In the direct method the eye of the observer is brought close to that of the patient, the mirror only intervening, and the observer looks into the eye, and sees the structures within in their natural positions, as real objects, magnified by their own crystalline lens. The position is shown in the figure, which is a diagrammatic section of the two heads and the mirror. The heads are inclined a little obliquely, and the left eye should be used for the examination of the left, and *vice versâ*, to avoid contact between the faces or annoyance from the breathing. In the diagram the observer, A, receives the light from the flame upon his mirror, directs it into the left eye of the patient, B, and sees the fundus of B's left eye through the perforation in the mirror. The statement that only the mirror is interposed is only true when both eyes are normal-sighted. If either of them is shortsighted the defect must be corrected by a concave lens of proper strength, and if either of them is flat or hypermetropic the defect must be corrected by a convex lens of proper strength, before a perfect picture will be obtained. In either case the correcting lens is most conveniently placed in a clip behind the mirror, or in a revolving disc carrying several lenses, so that different ones may be brought over the sight-hole by simple rotation.

Indirect method.

In the indirect method the observer remains at some distance from the patient, and holds up near the eye of the latter, and in the track of the light, a strong convex lens, which produces, between itself and the observer, the inverted, aerial, brightly illuminated image of the fundus of the eye looked at. This image, and not the fundus itself, becomes the object of vision. By placing another convex lens behind the mirror the image may be magnified and rendered more distinct; but it can only be seen so long as the observer handles the mirror properly, so as to maintain the illumination, and so long as he keeps in a straight line with the eye examined, so as to be in the track

of the returning rays. The diagram shows the position of things. A is the head of the observer, B of the patient, whose left eye is under examination. The rays of light from the flame, received on the mirror and directed into the eye of B, are united on their return by the convex lens into the image I, and this image is seen by A, through the mirror perforation, as soon as he is at the proper visual distance from it, and as long as he keeps strictly on the line L B, along which he must move to and fro until the proper distance is obtained. If he moves laterally to A′ or A″ he loses the image entirely. The whole art of using the ophthalmoscope is comprised in keeping the eye of the observer in a line with that of the patient, in maintaining a steady illumination, and in finding the correct distance. The instrument is extremely simple both in construction and application, and any intelligent person may acquire the knack of seeing with it in half an hour, although the art of interpreting the appearances exhibited can only be gained by practice and reflection. The opportunities for learning to handle the ophthalmoscope are now so abundant that it is unnecessary to devote space, in a manual of this kind, to any more detailed description of the way in which it should be managed.

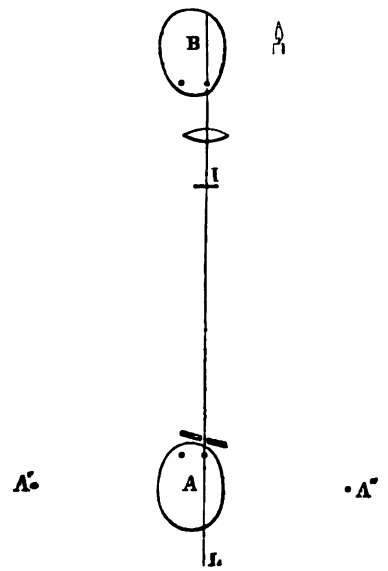


FIG. 344. Diagram of indirect ophthalmoscopic examination.

Among the diseases which involve the deeper parts of the eye the most important is glaucoma, and it owes its importance mainly to these circumstances—first, that its nature is often overlooked until irreparable mischief has been done; secondly, that if it is recognised in time it may in most cases be arrested or cured by the operation of iridectomy or of sclerotomy. The word glaucoma was originally applied, in a very vague manner, to nearly all cases in which the blackness of the pupil had changed to a greenish hue; but of late years it has come to have a perfectly definite meaning which stands in no sort of relation to its etymology. It is used to denote all the morbid conditions which arise from increased hardness or heightened tension within the eyeball; and it is coupled with adjectives which denote different periods of duration—such as 'chronic,' 'sub-acute,' 'acute' and 'fulminating.'

Glaucoma.

Concerning the essential nature of the processes by which the fulness or tension of the eyeball may be increased there is nothing certainly known; but they are conjectured to be increased secretion, as an effect of some perversion of nervous action, and diminished exhalation or transudation, as an effect of some change—probably senile hardening—of the tissues of the eye; these conditions possibly existing either singly or in combination. Recent researches have led to the belief that exhalation from the eye occurs chiefly through an annulus of tissue immediately in front of the periphery of the iris, and behind the true cornea, a region which has received the name of the 'filtration area.' When a state of over-fulness of the eyeball is once produced it tends to maintain and to increase itself, partly because the veins

Its nature and degrees.

vorticosæ, which convey blood from the choroid, pierce the sclerotic so obliquely that their channels are compressed and partially closed by any increment of fluid within the globe, and partly, also, because the iris, as soon as it is slightly pushed forward by fluid behind it becomes applied as a sort of valve against the filtration area, and still further impedes the exit of fluid. Hence a certain degree of venous congestion or blood-stasis is produced, and may lead to transudation of liquor sanguinis and consequent œdema. Notwithstanding the retarded outflow of blood the arterial inflow continues, even if in diminished quantity, and in this way a steadily increasing degree of pressure may be brought about. The natural or physiological tension of the eye varies, in different people, within rather wide limits, and the instruments which have been devised for measuring it with exactness are of no great practical value. The best estimate of tension for clinical purposes may be made by careful palpation, but careless palpation may lead to very erroneous conclusions. The patient should be directed to look downwards, closing the lids gently, and the surgeon should place the tips of the two forefingers on the upper part of the eyeball, close under the orbital margin, as far back as the closed lid will allow. One forefinger should be used to steady and support the eye, the other to feel its degree of hardness by gentle and intermittent pressure. A healthy eye will dimple somewhat under the finger, with a peculiar slight elastic resistance; and a diseased one may be either too hard or too soft. Mr. Bowman proposes to recognise nine degrees of tension—the normal, four of increase, and four of diminution. He distinguishes the normal tension as T. n., and the four varieties by a T with a *plus* (+) or *minus* (—) sign, and with either a note of interrogation or a numeral. T + ? is doubtful increase; T + 1, distinct increase; T + 2, considerable increase; T + 3, great increase; while the minus sign indicates diminution of tension in the same manner. This method of stating tension is now in general use; although it has the obvious defect of affording no definite standard for any of the degrees which it records.

Its effects.

The manifest effects of heightened tension are produced, first, upon the circulation of the eye; next, upon its nerves; lastly, upon its tunics; and they differ in their more marked characters in accordance with the rate at which tension increases. If the increase is very slow the tunics accommodate themselves to it, and, for a time at least, yield painlessly, while the sensibility of the retina is slowly destroyed by compression and by arrested circulation. If the increase is rapid the stretching of the tunics is acutely painful, and, together with the sudden disturbance of the circulation, produces inflammatory reaction. Hence chronic glaucoma is liable to be mistaken for atrophy of the optic nerve, and acute glaucoma is liable to be mistaken for inflammation. In consequence of the attendant pain it has often been mistaken for gouty or rheumatic inflammation, and has been suffered to go on to blindness before its true nature has been discovered.

On the circulation.

As soon as the free exit of blood through the venæ vorticosæ is impeded, an endeavour is made to obtain the necessary outlet through other channels, and chiefly through a series of veins which pass out from the eyeball through the sclerotic not far from the corneal margin, and course backwards under the conjunctiva. In health these veins are scarcely visible, but heightened tension renders them distended and tortuous, carrying dark-coloured blood. They then become plainly visible under the conjunctiva, and can hardly be mistaken for the veins proper to that membrane. At the same time a remarkable phenomenon is produced in the vessels of the retina, which con-

stitute a closed circuit of their own, almost independent of that of the rest of the eye. Of course, when there is increased tension, the entrance of blood through the central artery of the retina and its exit through the central vein are both impeded, and the result is the production of a visible pulse in the larger portions of these vessels where they lie upon the surface of the optic disc, first in the veins, secondly in the arteries. The observer, looking at the optic disc with the ophthalmoscope, sees it alternately more and less pallid, the variations occurring synchronously with the radial pulse. What first happens is that the blood in the veins is driven a little back towards the capillaries, so as to make room for the entering arterial wave, the walls of the veins collapsing, and the disc losing colour, until as the pulse wave flags the blood in the veins flows back again, and is thus constantly driven to and fro. The venous pulse, therefore, consists of an emptying of the veins from the centre of the nerve-disc to its margin, alternately with a reflux of blood from the margin of the disc to the centre. A venous pulse may be readily produced in most eyes by pressure upon the globe with the tip of a finger, and it is an early symptom in glaucoma, occurring either spontaneously or under very light pressure indeed. As tension increases the arterial blood can no longer enter in a continuous flow, but only during the acme of the pulse-wave, so that the arteries collapse during the cardiac diastole, producing a visible arterial pulse, the reverse of that in the veins, the arteries emptying themselves from the margin of the disc to the centre and refilling from the centre to the margin. It must be observed that these pulses, arterial and venous, are neither peculiar to glaucoma nor pathognomonic of it. They indicate increased resistance to the entrance of blood, or diminished propelling force; and they only point to glaucoma when there is a distinct increase of tension. In some eyes a venous pulse is a physiological phenomenon, and it can be produced in all by pressure. An arterial pulse may be due to defective power of the heart, or to aortic regurgitation, or to heightened tension and increased resistance of the blood-vessels.

On the nerves.

The effect of heightened tension upon the nerves of the eye is to impair their function, and sometimes to alter their physical structure by direct compression.

The motor, vaso-motor, and common sensory nerves are the long and short ciliary, which receive twigs from the third and fifth cranial nerves and from the sympathetic. They course between the choroid and sclerotic, and during the progress of glaucoma they are squeezed against the latter tunic. If the compression to which they are subjected is slight it produces numbness or imperfect function; if greater, it may excite the sensory nerves to pain. On the retina, the effect is to render it torpid to the impressions produced by light, and ultimately insensible to them; and the optic nerve, the surface of which is mechanically the least resisting part of the eyeball, is often forced back in such a manner that it becomes an excavation or pit, instead of being slightly prominent as in the natural state. The nerve-fibres, bending round the edge of this pit almost at a right angle, are squeezed against the margin of the sclerotic opening and undergo wasting, by which this margin itself is rendered conspicuous; while the blood-vessels, following the same course, may be seen to bend in a similar manner, and the portions on the floor of the cup may even appear to be disconnected from their continuations on the retina.

Course and symptoms.

In extremely chronic cases the progress of glaucoma may be almost uniform, and may be quite painless. The symptoms are gradual failure of

vision, attended by gradual hardening of the eyeball. The peripheral parts of the retina are not only compressed, but by reason of their distance from the centre of circulation their blood-supply is checked sooner than that of the central portions; and hence it happens that they are the first to show failure of sight, and that the blindness of glaucoma affects the outer part of the field of vision, and contracts or diminishes its extent, even while central vision may be but little impaired. At the same time there will be some diminution of the natural sensitiveness of the cornea, and the ophthalmoscope will show a slight depression of the surface of the optic nerve, generally with pulsation in the veins. In the subacute form the pressure does not increase regularly, but at uncertain periods, which are separated by remissions; and the symptoms may be divided into the premonitory and the actual. The premonitory symptoms are some diminution of the acuteness or some contraction of the field of vision, together with failure of the power to adjust the eye for near objects; so that the patient, who is usually past middle age, requires stronger spectacles than would be suited to his years, and may require to strengthen them once and again at short intervals. Very often there will be some irregular dispersion of light by the media of the eye, so that a candle flame appears to be surrounded by a halo of prismatic colours. After a longer or shorter duration of such symptoms as these the patient experiences a sudden attack of pain, attended by obscuration of sight, which may be either complete or comparable to a fog or mist, and which may pass away in a few minutes or not for some hours, but which seldom leaves vision as good as it was before. It also leaves a very decided increase of tension, and sometimes a deep excavation of the disc. Such attacks occur again and again, and presently they establish a permanently glaucomatous state, in which the iris and lens are pushed forward towards the cornea, so that the depth of the anterior chamber is diminished, in which the pupil is somewhat dilated, and often elliptical, with the major axis horizontal, and in which the anterior veins which perforate the sclerotic near the cornea are dilated and tortuous. At this stage the cornea is often steamy, and the vitreous hazy, so that no good view of the fundus can be obtained, and there is often an amount of pain and of conjunctival congestion which may lead unskilled persons to apply remedies for the cure of an imaginary gouty or rheumatic 'sclerotitis' or ophthalmia.' In the acute form the paroxysms are nearer together, the remissions less decided, and the course is more rapid; while in the fulminating form sight may be hopelessly destroyed in the course of a few hours. In all forms, unless they are arrested, total blindness is the inevitable ultimate result.

Treatment. The only treatment which is of any permanent avail against glaucoma is the operation of iridectomy or of sclerotomy, one of which should be performed in every case as soon as the nature of the disease is recognised, so long as any vision remains. The effect of either operation is to diminish tension and to restore, more or less completely, the natural elasticity of the eyeball, so that the circulation can be re-established, and the nerves may recover from the compression to which they have been subjected. As a general rule, an operation may be expected to arrest chronic glaucoma and to preserve the sight which remains, but not to produce more than a slight degree of improvement, gradually developed during the two or three months after the operation. In subacute and acute cases it is useful almost in proportion to the acuteness, and may even restore sight to its natural standard. Occasionally it only temporarily reduces tension, and in some (chiefly chronic)

cases the reduction of tension fails to arrest atrophy of the nerve, which leads to blindness. Still an operation always affords the only prospect of doing good, and it should never be delayed in the hope of amendment under any other practice. Notwithstanding all that has been said and written on this subject during the last few years, the profession generally is hardly yet aware of the great importance of early iridectomy or sclerotomy in all cases of glaucoma. The precise way in which either operation reduces tension is hardly determined, but in the former it is probably partly by the actual removal of a large piece of iris, which is also a secreting surface, and in both by the formation of a comparatively permeable cicatrix in the ocular tunics.



Fig. 845. Lance-knife for iridectomy.

Operation of iridectomy.

In order to perform iridectomy for the relief of tension it is necessary to remove a large piece of iris and to remove its entire width quite up to the ciliary attachment. The portion selected should usually be the middle third, or more than the middle third, of the upper half, so that the gap, unless the eye is very prominent, may be partly or entirely concealed by the upper lid, and may neither be unsightly nor disturbing to vision. If the anterior chamber is tolerably deep a lance-knife (Fig. 845) may be used, and the incision made by a single thrust; but if the chamber is shallow, so that the lens would be exposed to risk, it is better to use a linear knife by puncture and counter-puncture, as for the extraction of cataract. The patient being recumbent and fully etherised, and the lids separated, the operator seizes the conjunctiva with fixing forceps at a point opposite the centre of his intended incision. If the lance-knife is used its point is placed on the centre of the intended incision, about half a line behind the corneal margin, and is thrust gently through until it can be seen in the anterior chamber. It is then directed somewhat forward, and thrust steadily on over the opposite margin of the pupil until nearly the whole width of the blade has entered the eye. It is then gently but quickly withdrawn. The operator next introduces a pair of iris forceps, seizes the iris near the pupillary margin, draws it out, cuts it through with scissors quite up to the ciliary margin at one end of the wound, tears it from its attachments up to the other end, and cuts it through there in the same manner. If a portion of iris remains entangled at either end of the wound it must be cut off if possible, or it may be made to return into the chamber by light friction through the closed lid, or it may be replaced by the end of a fine probe. Any coagula should then be removed from the sac of the conjunctiva, the eyelids closed, and secured as usual by a bandage.

Sclerotomy.

In order to perform sclerotomy, a narrow knife should be introduced into the anterior chamber, by puncture and counter-puncture, precisely as in the operation for senile cataract; but, instead of turning the edge forward when the counter-puncture is completed, the plane of the blade should be kept parallel to that of the iris, and the edge should be made very gently to cut its

way out through the filtration area, until the whole of the subconjunctival tissues are divided. The knife should then be withdrawn, leaving a central bridge of conjunctiva uncut. The eye should not be bandaged, but only covered by a piece of wet lint; the object being to permit the section to gape a little, and to be filled up by new and permeable tissue. In a nicely performed sclerotomy the track of the wound should remain quite visible under the conjunctiva, as a line of perceptible width, when healing is complete.

Relative merits of iredectomy and sclerotomy.

With regard to the relative merits of the two operations, the time has hardly come for pronouncing a positive opinion. As far as evidence has been obtained, it points to the conclusion that iridectomy is to be preferred in acute cases, and that sclerotomy is at least equally effectual with iridectomy for chronic cases. It is probable, however, that much of the efficacy of sclerotomy depends upon the precise position of the incision.

Eserine.

The local application of eserine, in the manner already described when speaking of corneal ulceration, should never be omitted in glaucoma. In acute cases the drug appears actually to diminish tension, and hence to diminish urgency, acting probably upon the vaso-motor nerves. In chronic cases if it diminishes tension at all, it is only by drawing the periphery of the iris away from the filtration area; but in both the contraction of the pupil greatly facilitates either iridectomy or sclerotomy, protecting the lens against accidental injury, and assisting to prevent entanglement of the iris in the wound.

Iridectomy for artificial pupil.

When iridectomy is not required for the relief of tension, but only for an artificial pupil to afford vision though some clear part of the media, the method of performance is essentially the same, but with the difference that only a small piece of iris need be removed, and that the place selected must be that where the best sight will be obtained, that is to say, generally speaking, wherever there is the best piece of clear cornea. The puncture may be made with a lance-knife of small size, and the piece of iris which is drawn out, instead of being cut and torn, may be simply cut off close to the forceps, and the rest suffered or coaxed to return into the eye.

Diseases of the deeper parts of the eye.

The ophthalmoscope reveals a great number of changes in the deeper parts of the eye, changes which for the most part belong rather to the domain of medicine than of surgery. Thus, in Bright's disease the retina becomes the seat of patches or flecks of white or glistening fatty degeneration, usually interspersed with hæmorrhages; and hæmorrhages may also take place from the retinal arterioles in hypertrophy of the heart, or in atheroma of the vessels, or as an accidental result of the plugging of a considerable branch by an embolus. Venous retinal hæmorrhage occurs in several forms of venous obstruction or passive congestion, in many cases of disordered or interrupted menstruation, and in certain blood-diseases, such as purpura. The optic nerves are liable to become swollen and prominent in some forms of intracranial disease, and notably in intracranial tumours, and this condition is often called 'optic neuritis.' It is probably essentially an œdema, attended with more or less inflammatory reaction. It may be entirely confined to the connective tissue which unites the fibres, and may thus be present in a very pronounced degree without affecting vision, although even then it may lead to secondary atrophy of the nerve, by which ultimately vision may be totally destroyed. Whenever there is a syphilitic history and headache, the swelling of the optic discs would point to the probable presence of a gummatous tumour in the brain, and would demand the prompt administration of full doses of

iodide of potassium. The retina is not unfrequently studded with patches of syphilitic deposit around which some inflammatory action may take place; and retinal inflammation may also be excited by the tissue-disturbance incidental to hæmorrhage. Perhaps the only primary inflammation of the retina is the very chronic disease which is known as 'pigmentary retinitis,' in which, over a broad zone the inner margin of which is at some little distance from the optic nerve, the fundus of the eye is strewn with irregular strips and patches of black pigment, the nerve itself being pallid and its arteries dwindled. The symptoms of pigmentary retinitis are comparative blindness at night and contraction of the field of vision, and it is due to chronic inflammation, which involves the perceptive layer of the retina and the subjacent choroid, and disorganises both. The disease is very slowly progressive, and eventually destroys sight; but there is some reason to believe that its rate of progress may be retarded by the persevering administration of preparations of iron. Besides the presence of adventitious deposits and the occurrence of inflammation, the retina is liable to be absolutely detached from the subjacent choroid and elevated like a blister by effused fluid beneath. Such an elevation is seen by the ophthalmoscope as an irregular, mobile, whitish prominence, crossed by the retinal vessels, and thrown into tremulous vibrations by the movements of the eye. Attempts have been made to procure the subsidence of the elevation by lacerating it with needles, so as to permit the fluid beneath to escape and mingle with the vitreous; but none of these attempts have been attended with any great measure of success.

Diseases of the choroid.

The choroid, besides the acute inflammation which may extend to it from the iris, is liable to chronic inflammation, which is only discoverable by the ophthalmoscope, and which may be either disseminated in scattered patches or diffused generally over the surface. The pathology of choroiditis is by no means completely understood, but it is probably due to syphilis in a great majority of the instances in which it occurs; and in the cases which are not syphilitic it is often associated with a high degree of myopia, which appears to be an exciting cause on account of the mechanical strain thrown on the posterior hemisphere of the eyeball by excessive convergence. Choroiditis is often more immediately and more permanently injurious to the sight than any of the forms of so-called retinitis; for the latter may affect the connective tissue of the fibre layer, scarcely at all interfering with the perceptive elements beneath, while the former necessarily involves the inner or capillary layer of the choroid, from which the perceptive elements of the retina derive the materials of their nutrition. In its earlier stage choroiditis is attended by effusion, and this is succeeded by atrophy of the affected part of the membrane, which may waste and disappear entirely, so as to uncover the white surface of the sclerotic. At the same time the affected patches usually become bordered by black pigment. All these changes are often present together, with the effect that a case of choroiditis, when examined by the ophthalmoscope, presents a general effect of variegation or 'marbling' of the fundus of the eye, the natural orange-red or brownish-red surface being interrupted by patches of effusion, patches of progressing or of completed atrophy, and black deposits of every variety of outline.

Their treatment.

A case of choroiditis sometimes comes under observation only when the storm has spent its force and when atrophy has made considerable progress. For such no treatment is required; but whenever a careful examination discovers patches of recent or still existing effusion the disease is continuing.

It is then necessary to consider the question of syphilis, and to treat it if it exists, or if on any good ground it is strongly suspected. Apart from this, rest of the eyes must be enforced; they must be sheltered from strong light by shaded rooms and dark blue spectacles; blood may be taken from the temples by cupping or by Heurteloup's artificial leech, and iodide of potassium or perchloride of mercury may generally be administered, together with such other constitutional remedies as circumstances may require. In some cases of this class, and in some of intra-ocular hæmorrhage, great improvement has followed the hypodermic administration of pilocarpine as a sudorific repeated two or three times a week for a considerable time.

Diseases of the vitreous.

It is an open question whether the vitreous body is itself susceptible of inflammation. Cases have been recorded in which deposits of pus were found in its very centre; but experiments on the lower animals, so far as they may be accepted as conclusive, tend to show that apparent inflammation of the vitreous is a condition propagated from its containing membranes. However this may be, the vitreous is often turbid in retinitis or choroiditis; and it may be so turbid as completely to conceal these conditions. It is often discoloured by blood in cases of intraocular hæmorrhage, and is sometimes beset by membranous flocculi, which float about in such a manner as to show that the humour has lost its natural gelatinous consistence and has become fluid. All these conditions are evidences of profound nutritive disturbance, and justify a grave or at least a very cautious prognosis. Unless other indications are present, turbidity of the vitreous generally calls for counter-irritation on the temple, and for the administration of perchloride of mercury or of iodide of potassium, under which treatment, in a certain number of cases, very considerable restoration of transparency may be brought about. Von Graefe has recorded a single instance in which a membranous film occupied the vitreous chamber and stretched across it behind the lens in such a way as almost entirely to destroy vision. Having satisfied himself of the position of the film, he lacerated it by two needles introduced behind the ciliary region, and succeeded in making a central aperture through which excellent sight was ultimately obtained.

Morbid growths within the eye.

The vitreous chamber of the eye is liable to be the seat of malignant growths of two distinct classes—sarcomata, which commence in the choroid or iris; and gliomata, which commence in the connective tissue of the retina. Both alike destroy vision at an early period of their progress, both produce enormous enlargement and projection of the eyeball, and both, when its coats give way, protrude as fungous and bleeding masses. The sarcomata prove fatal mainly in this way: wearing out the patient by pain and exhaustion; but the gliomata still more speedily, by spreading backwards along the optic nerve and optic tract, and occasioning the formation of secondary tumours in the brain. Sarcomata are extremely rare; and Knapp, in his treatise on intraocular tumours, records only eight cases originating in the choroid, and two originating in the iris, in one of which, as the growth was not removed, the diagnosis was not absolutely certain. I have myself published a case of multiple round-celled sarcomata of both irides,[1] which remained two years under observation with only slight increase of the growths. Gliomata are more frequently met with, and usually occur in young children. The presence of a tumour within the eye is made known by impairment or loss of vision, by projection forward of the lens and iris

[1] 'Trans. of Clinical Society,' vol. vii.

towards the cornea, by increased hardness of the globe, by tensive pain and inflammatory reaction of a degree proportionate to the rapidity of increase of the growth, and by the visibility of the tumour itself. The gliomata are white or primrose-yellow in colour, and soon become conspicuous through the pupil: but the sarcomata are yellowish or reddish, often contain melanotic pigment, and are less easily discoverable. Still, by dilatation of the pupil and by focal and ophthalmoscopic illumination, a new growth can generally be seen if carefully looked for; and no absolute certainty about the nature of any intraocular growth can be obtained prior to its removal. In a few instances an intraocular tumour has proved to be no more than a mass of tubercle; and I have seen one case in which the appearance of a tumour was closely imitated by a deposit of yellow gelatinous lymph on the posterior surface of the lens. A far more dangerous error has been occasioned by the white colour of a glioma, which, seen through the still transparent lens, has been mistaken for cataract. The unnatural hardness of the globe, the projection forward of the iris, and the total loss of sight, should render such an error impossible.

Whatever may be the nature of an intraocular growth, enucleation of the eye should be performed without delay; and, in a case of glioma, the optic nerve should be severed at the apex of the orbit, instead of immediately behind the globe. For this purpose the best instrument is a probe-pointed bistoury, curved on the flat, which may be guided along the nerve-trunk as far as possible before being made to divide it. The results of early removal of the eye in sarcoma are fairly good, half of Knapp's cases having undergone no relapse, while the other half died of secondary growths in internal organs. This result followed in a case of my own, in which I removed an eyeball containing melanotic sarcoma, and intensely painful, in 1877, and the patient died of intra-thoracic melanotic tumours in 1883, having had nearly five years of immunity from suffering. In glioma the prognosis is much less favourable; and Hirschberg has been able to collect only five cases in which the diagnosis was established beyond doubt by microscopic investigation, and in which the patient remained under observation for a sufficiently long time to render it certain that a permanent cure had been effected. In one of these cases I was the operator, and the patient was still in good health after the lapse of thirteen years. In two other cases of mine there has been no recurrence for some months, and the children have then been lost sight of, their parents having promised to bring them without delay if any symptoms of a return of the growth appeared. On the whole, I think the evidence is in favour of a belief that recurrence may be prevented by sufficiently early enucleation, while the glioma is still wholly included within the eye; and that the unfavourable cases are those in which the disease has already made its way along the optic nerve to beyond the point of section. I read before the Clinical Society [1] a very instructive case of congenital glioma of both retinæ. The right eye was removed during the third month, and the character of the patches on the retina was determined by microscopic examination. The parents refused to permit removal of the left eye until, when the child was three years old, it had become greatly enlarged and acutely painful. Removal was then performed, and, in a forlorn hope that the brain might have escaped, the whole contents of the orbit were cleared out by the galvanic cautery, and the cavity was lined with chloride of zinc paste. The child died a few days afterwards, and a large mass of intra-

[1] 'Clin. Soc. Trans.' vol. vii. p. 65.

cranial cancer was found on the left side; but the right side was free from disease, and the right optic nerve had dwindled to a fibrous cord quite up to the chiasma. There can be little doubt that if both eyes had been removed in infancy the child's life would have been saved.

When a malignant growth has already occasioned enlargement of the eyeball, or has perforated its coats, the expectation of preserving life is scarcely to be entertained; and an operation can only be undertaken with a view to the relief of suffering by the removal of the acutely sensitive textures of the eyeball and its appendages. For such a purpose the removal should be as complete as possible, and should include all the tissues within the orbit. The enlarged ophthalmic artery will generally bleed freely; and it may be necessary to apply the actual cautery, or to plug with compresses moistened with solution of perchloride of iron, and secured by firm pressure with a bandage.

In the few cases in which a tumour within the eye is found, after enucleation, to be of a benign character, there can yet be no doubt of the propriety of the operation. A mass of tubercle or lymph would destroy the eye as an organ of vision; and in course of time might undergo osseous or calcareous change which might irritate the ciliary nerves and occasion sympathetic ophthalmia.

Injuries of the eye.

Like all other parts of the body, the eye is exposed to various kinds of accidental injury; and, although it is much sheltered from direct violence by the prominence of the margin of the orbit, and from small projectiles by the eyelashes, by the rapid and instinctive closure of the lids, and by the rotation of the cornea upwards, which occur at the slightest intimation of danger, yet the peculiar vulnerability of the organ causes it to suffer severely from casualties which would be unfelt or unnoticed elsewhere. The intense irritation occasioned by the presence of minute foreign bodies is familiar to most persons, and is perhaps experienced in the greatest degree when the intruder is lodged in a very common position, beneath the upper lid and just within its margin, so that it scrapes the sensitive epithelium of the cornea at every movement. It is necessary to remember that a patient is often unconscious of the impact of a foreign body, and totally unsuspicious of its presence; and that while, if under the upper lid, it is concealed from view, it may also, if itself of dark colour, easily escape the notice of a careless observer when it is imbedded in the cornea over the region of the pupil, or even when it has a background of dark iris. In every case of suddenly occurring inflammatory irritation of the eye it is proper to evert the lid and to inspect its under surface, and also to scrutinize the surface of the cornea closely, and by the aid of light falling upon it at different angles, so that no foreign substance may be overlooked. In the out-patient departments of hospitals it is not uncommon to see persons who have been severely treated for ophthalmia, and who are cured at once by the removal of a morsel of iron or cinder, which had not been observed by the practitioner to whom they first made application.

Removal of foreign bodies.

When a foreign substance is lodged beneath the upper lid it may be removed in an instant, as soon as the lid is everted, by the point of a pen or of a penknife, or by the finger-nail: and the case will seldom require any further treatment. But when a similar substance is imbedded in the cornea its removal may be much more difficult, chiefly on account of the great sensitiveness of the surface. In the country the wing-case of a minute beetle

is a foreign body frequently met with, and this may be dislodged by a touch, as it is held against the cornea only by atmospheric pressure. In towns we have more frequently to deal with splinters of wood, or iron, or glass, or with fragments of cinder—these being especially common among railway-travellers who look out of window—and all such things, when they are really imbedded, require circumspection. They should seldom be touched with any sharp instrument, which would scratch the cornea as often as it failed to dislodge them; but they should be tilted out by means of a minute spatula, set in an appropriate handle. If the surgeon is unpractised at operations of this kind, and if the eye is irritable, it is better at once to place the patient in a recumbent posture, to keep the lids apart by a wire speculum, and to fix the eye by pinching up a fold of the conjunctiva with appropriate forceps, so that the removal may be done deliberately. If the patient is a child it is better to give an anæsthetic. When the foreign body is very small, or when it is inconspicuous by reason of its colour, an assistant should concentrate lamp-light or daylight upon it by a lens, as in focal illumination; and when it has nearly penetrated the cornea it may be supported from within during removal by a smooth blunt spatula, introduced into the anterior chamber through a preliminary puncture with a narrow knife or broad needle. Complete removal should be effected whenever it is possible, but it must be borne in mind that fragments of iron stain the tissues with which they have been in contact, and leave a discolouration when the whole of the metal is gone. This discolouration may be readily distinguished from the remains of a foreign body, because it is always an annulus with a transparent or colourless centre, a character which may be seen at once with a magnifying glass. After the removal of any imbedded substance the exposed corneal tissue is often highly sensitive; but it may usually be effectually sheltered from air and from the friction of the lid by the occasional application of a drop of castor-oil to the surface until healing is complete. The oil appears to act only mechanically; but where a foreign body has been long imbedded, and there is much irritation, sulphate of atropia may be dissolved in the oil by the aid of heat, in the proportion of two grains to the ounce, so as to obtain also the action of a medicinal sedative.

More severe injuries.

When a more severe injury has been inflicted, such as a violent blow or contusion, a punctured or incised wound, or the lodgment of a foreign body within the globe, the first care of the surgeon must be to consider whether the safety of the other eye is imperilled. It is now well established that injuries of a certain class are liable to produce what is called sympathetic ophthalmia; that is to say, an affection of the other eye, which commences as an apparently slight and very insidious plastic iritis, and which leads in nearly all cases, under whatever treatment, to ultimate wasting of the globe and destruction of sight. There is much reason to believe that the initial phenomenon of sympathetic ophthalmia is irritation of one of the ciliary nerves of the injured eye; and many instances are now on record in which such irritation has been conspicuously present, a ciliary nerve having been found imbedded in, and compressed by, the cicatrix, or even in a state of actual inflammation. Nothing is known with regard to the time during which such conditions may remain limited to the affected eye; but when once this time has passed, when the irritation has reached some central ganglion, and has been so reflected as to influence the nutrition of the sound eye, remedial measures are generally of little or no avail. As a general rule, it is almost always possible to prevent the occurrence of sympathetic

Sympathetic ophthalmia.

ophthalmia by the timely removal of an eye which is in a state likely to produce it; but it is seldom possible to arrest sympathetic ophthalmia when it is once produced. In every case of severe injury, therefore, the propriety of removing the injured eye must be a matter for serious consideration.

By what classes of injuries produced.

Sympathetic ophthalmia is produced, most quickly and certainly, by injuries which implicate the region of the ciliary body. Next in order come wounds which produce dragging upon the tunics of the eye by the contraction of cicatrices; next, cases in which chronic inflammation, whether produced or not by the lodgment of a foreign substance, spreads from the iris to the ciliary body; lastly, cases in which the effusion of plastic choroiditis becomes in time converted into bone. Whenever the ciliary region is at all severely hurt it is generally advisable to perform enucleation without delay; and in all extensive wounds it should be mentioned as a proceeding which events may render necessary. It should also be performed whenever, at any period after injury, the ciliary region becomes tender to the touch, especially if palpation discovers bony hardness in the deeper parts of the globe. Whenever an injury is so severe that the eye is manifestly destroyed as an organ of vision it is best to perform enucleation at once, as in primary amputation after injury before local inflammation is set up; but in less severe cases it is proper to wait and watch, since sympathetic ophthalmia seldom or never occurs prior to the time of cicatrisation, or of contraction of inflammatory effusions.

Sympathetic irritation.

A few cases are on record in which an injury which would ordinarily produce sympathetic ophthalmia has produced instead a state which has been called sympathetic irritation; in which, without any manifest morbid change, the secondarily affected eye has been rendered useless by hyperæsthesia, displayed by intolerance of light, lacrymation, and total want of power to exercise the visual function. Such cases have continued without improvement for long periods, and have been cured immediately by removal of the eye primarily injured, the patients, on recovering from the anæsthetic administered for the operation, having been ready to resume their duties in life. In one patient of my own, a wasted and irritable eye, containing a shell of bone, failed to affect its fellow, but produced a succession of attacks of general tetanic spasm, some of which were of great severity. After the removal of the eye the attacks abated in frequency, and soon entirely ceased.

Operation of enucleation.

The operation of enucleation, when the tunics of the eye are unbroken, is very easy of performance. The object is to remove the globe alone, leaving the whole of the muscles to coalesce and form a stump, on which an artificial eye may be supported in such a manner as to be freely movable. Besides the ordinary speculum, the only instruments required are a strabismus hook, a pair of strong fixation forceps, and a pair of strabismus scissors, curved on the flat, and with smooth and rounded points. The lids being widely separated, the operator pinches up the conjunctiva over the insertion of the external rectus muscle and divides it, with its subjacent tissue, down to the surface of the tendon. The tendon is then lifted on the hook, and cut through in such manner as to leave not more than a line of its length attached to the sclerotic. Seizing this remaining portion with the forceps, the operator rotates the eye strongly towards the nose, then introduces the scissors at the wound and carries them round the posterior hemisphere of the eyeball, so that their blades may include the optic nerve and may divide it close to the sclerotic. Retaining his hold he pushes one blade of the scissors under the tendon of the inferior rectus and divides it, and the conjunctiva covering it.

at one stroke; and then divides the tendon of the superior rectus in the same way, in both cases cutting close to the eyeball, which can then be lifted out of the orbit, prior to the division of any remaining attachments of the oblique muscles, and of the internal rectus and conjunctiva. When the tunics of the eye are broken the operation is less easy, and resolves itself into a careful dissection with scissors, the points of which must be kept close to the sclerotic. As soon as an eye is removed the closed lids must be covered by a sufficient packing of sponge to afford a basis for firm pressure with a bandage. The sponge may be removed in three or four hours, when all tendency to bleeding has ceased; but if it is not efficiently applied, or if it is removed too soon, blood will find its way into the connective tissue, and will produce extensive ecchymosis of the lids and cheek, which may not disappear for weeks. When the sponge is removed no other dressing than a simple covering will be required; and in about ten days the patient should begin to wear a glass scale, as a step towards a properly fitted artificial eye.

Contusions. Contusions of the eye, if they do not rupture the cornea or the sclerotic, are generally recovered from with comparatively little injury, unless they produce very large hæmorrhage from the choroid, or detachment of the retina, both rare occurrences. Hæmorrhage into the anterior chamber, even if considerable in amount, is usually quickly absorbed without doing mischief; and detachment of some portion of the iris from its ciliary margin, although it forms a second pupil and alters the shape of the natural one, is seldom followed by any serious consequences. If the capsule of the lens is ruptured, so as to admit the aqueous humour to the cortex, traumatic cataract will be produced; but if the pupil is kept well dilated, absorption will usually go on quietly, without inflammation or distress. In all such cases, besides the use of atropine, the treatment should consist of spirit-lotion, anodynes if there should be pain, a leech or two if there should be any appearance of inflammation, and careful watchfulness of the course of events. Sometimes the nucleus of the lens may resist absorption by reason of its hardness, and may ultimately require extraction.

Dislocation of the lens. Sometimes the lens, possibly in its unbroken capsule, may be dislocated into such a position that it troubles the iris or ciliary region by pressure. In all cases the principle is the same, to wait and watch, and only to interfere surgically if interference is manifestly required. The same may be said of cases in which the sclerotic is ruptured but the conjunctiva remains unbroken. Under such circumstances the lens is sometimes driven out of the eye, and appears as a prominence under the conjunctiva. It must be treated like a false cartilage which has been pressed out of the knee-joint into the subcutaneous tissue: not removed, that is, until the wound in the deeper tunics has had time to unite and consolidate. The conjunctiva may then be divided with scissors, and the lens tilted out of its new bed.

Contusions with rupture. When the tunics are completely ruptured by a contusion, and the fracture, so to speak, is originally compound, the results are generally disastrous. There is usually a free escape of vitreous humour and a good deal of bleeding; and only an imperfect restoration of sight can be hoped for. The treatment is practically the same as for more simple injuries.

Incised or punctured wounds of the cornea; Incised or punctured wounds occur most frequently in the cornea, the former often from breakages of glass, especially from the bursting of bottles containing effervescent liquids, the latter often from the endeavours of children to unfasten knots or bootlaces with a fork. Incised wounds are sometimes met with in the sclerotic, where they give little trouble, and

where they may be united, if large, by a single point of fine suture. Incised wounds of the cornea alone, if cleanly cut, will often unite with no worse consequence than an opaque linear cicatrix, which possibly may produce some change in the corneal curvature. The only treatment necessary is to apply a compressive bandage, and to endeavour to keep the iris away from the injury, so that it may not become adherent to it. This is best accomplished, if the injury is central, by atropine dilatation: and if it is marginal, by using in the same manner a solution of sulphate of eserine (gr. i. ad f ʒ iii) to produce complete contraction of the pupil. When a corneal wound is followed by extensive adhesion of the iris to the cicatrix, it is best to relieve the iris from traction by excising a piece of it in the opposite direction.

of the iris and lens.

It will happen most usually in incised wounds, and almost always in punctured wounds of the cornea, that the iris or the lens, or both, will participate in the injury; and a punctured wound, if inflicted by a blunt fork or by a shot-corn, will have much the character of a contusion. In all such cases, if any foreign body remains within the eye, it should be extracted if possible; and if it should be lodged in the iris it should be extracted by excision of the piece in which it is so lodged. It is not always possible to be sure whether a foreign body, such as a shot-corn, has lodged or escaped; but where there is good reason to suspect lodgment, and the injury is severe, it is better to perform enucleation without delay. If the injury is not manifestly severe it is right to wait for a time, and to be guided by the course of events. When traumatic cataract is produced it should generally be removed by suction or extraction; and when iris is incarcerated in a corneal wound the hernia should either be reduced or excised. In all cases inflammation should be combated by cooling applications and by the control of pain, as well as by suitable general management of the case; and the issue will depend upon the success with which this is done. In many cases severe injuries lead to wasting of the eyeball; in some they are recovered from with no worse injury than some impairment of vision, due to distortion or partial opacity of the cornea, or to loss of the crystalline lens.

Injuries from corrosive substances.

A class of injuries of a different character from any of the foregoing may be produced by burning, or by the introduction of corrosive substances into the sac of the conjunctiva. Lime is perhaps the agent of this kind which is most commonly introduced by accident, and corrosive acids are sometimes thrown over the face with criminal intent. The first thing to be done in such cases is to evert the lids, to remove all solid substances, such as fragments of lime or mortar, grains of unburnt gunpowder, and so forth, and then to wash the exposed surfaces thoroughly with a syringe and warm water, so as to remove finer particles or chemically irritant liquids. Atropinized castor-oil should then be applied to the conjunctiva, and evaporating lotion or other suitable dressing to the closed lids. Sometimes the cornea is destroyed or disorganised, and rendered opaque, and vision is wholly lost; but in many cases the upper half of the cornea has been sheltered by the upper lid, and has escaped either entirely or without serious injury. Very often, however, the lower portion of the cornea is denuded of epithelium, and the lower portion of the conjunctiva, both ocular and palpebral, is extensively destroyed; and when this is the case the opposed raw surfaces unite during the healing process, and produce that adhesion of the lid to the eyeball which is called symblepharon. This state is not only exceedingly distressing from its interference with the movements of the eye, but it also feeds the corneal cicatrix by the conjunctival vessels, and renders it fleshy and opaque.

Symblepharon.

Symblepharon was practically incurable until Mr. Teale of Leeds devised a very ingenious operation for its relief. After separating the united surfaces by dissection, he brings down a bridge, or two flaps, of conjunctiva from above the cornea, and transplants them to fill the gap below it. In this way raw surfaces are no longer in contact, and it is found that very extensive union may thus be treated with entire success; and, generally speaking, with excellent eventual results as regards vision. It would probably be advisable to apply M. Reverdin's method of grafting to the prevention of symblepharon, by placing grafts of conjunctiva below the cornea before the original union had taken place, and as soon as the raw surface was granulating.

Affections of the external ocular muscles.

The affections of the external ocular muscles require the careful consideration of the surgeon. It is the function of these muscles, in their healthy condition, to keep the two eyes constantly directed to the same object, or the same point of an object, so that the images formed by the refracting media may fall upon corresponding points of the two retinæ, and may be combined so as to produce a single effect upon the consciousness, and to afford the benefits of binocular or stereoscopic vision. When the muscles generally are out of harmony, or when any one of them, or any pair of them, are suffering from paralysis, from spasm, or from excessive tonic contraction, the two images no longer fall on corresponding points of the two retinæ, and diplopia or double vision is produced. If one eye is normally and the other abnormally directed, the image seen by the former is described as the true, that seen by the latter as the false image; and diplopia is further described as 'homonymous'—when the right-hand image belongs to the right eye, and the left-hand image to the left; or as 'crossed,' when these conditions are reversed. Homonymous diplopia is produced by convergent deviation, crossed diplopia by divergent deviation; the apparent position of the false image, in every case, being in the opposite direction to that of the actual deviation of the centre of the cornea. In order to determine with certainty the eye to which each image belongs, we give the patient a lamp or candle flame, eight or ten feet distant, as an object of vision, and place a slip of red glass before one of his eyes. The image of that eye will appear to be of a red colour, and its position with regard to that of the other can be immediately identified. The reason of the apparent deviation of the image will perhaps be rendered more intelligible by Fig. 846, in which A represents a right eye, naturally directed in order to look at an object, B, placed in front of it, and receiving the rays of light from B on the yellow spot, just external to the optic nerve. There is also another object, lying far to the right, at C, and the rays from this object fall upon the retina on the inner side of the optic nerve. At A′ we have the same eye, no longer directed forwards, but twisted inwards, as if by spasm of the internal rectus muscle. As the eye rotates about a centre, the outward excursion of the posterior hemisphere is equal to the inward excursion of the anterior hemisphere, with the result that the rays of light from an object

Double vision.

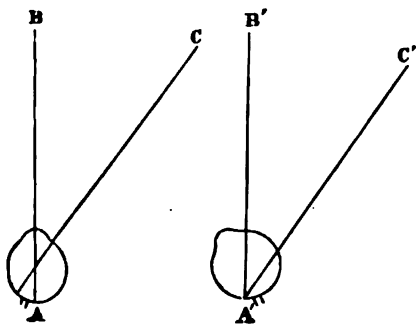


Fig. 846. Diagram to illustrate the formation of double images.

in the position B′ are no longer received upon the yellow spot, but upon a point of the retina on the inner side of the optic nerve, which in the natural state receives rays from the far right only. Hence the consciousness misinterprets the impression which it receives, and refers the ray coming from B′ to an object situated at C′; or, as it is said, projects the image in that direction. The same principle applies to every deviation of the cornea, whether it be vertical, horizontal, or in some intermediate direction. The intensity of the false image will be greater the nearer it falls to the yellow spot, and the smaller, consequently, is its apparent departure from its proper position. A very slight deviation of one eye, so slight as to be scarcely perceptible, may leave the patient constantly in doubt between the false image and the true—unable to distinguish them apart with certainty or to direct his steps with confidence—and suffering, often severely, from vertigo; while a large deviation suffers the false image to fall upon a peripheral part of the retina, where it is neglected by the consciousness, so that the patient, although he suffers little manifest inconvenience, is practically rendered one-eyed.

Squint. The most conspicuous form of loss of harmony between the ocular muscles is that which is seen in common convergent strabismus, or squint. This affection commences in early childhood, usually between two and six years of age. At first, when the child is looking intently at any near object, the two eyes are seen to be equally convergent, but directed to a point still nearer than the object; and, after a while, the eyes become slightly and equally convergent when they are at rest; that is to say, when they are not directed to an object at all. The next step is that the eyes, when looking at a near object, are no longer equally convergent: one being directed to the object, the other deviating inwards; and after a time this relative position becomes habitual, with the difference that the squint may be fixed—the right eye always looking forwards, and the left inwards, or *vice versâ*, or alternating, sometimes one eye deviating and sometimes the other. It is convenient to distinguish the eye which is directed forwards as the working eye, and that which deviates as the squinting eye.

Its pathology. The pathology of squint is very simple. The children in whom it occurs are, as a rule, hypermetropic, or flat-eyed; that is to say, their retinæ are situated within the focal length of their crystalline lenses. In order to obtain clear vision, even of distant objects, they are compelled to neutralize their defect by rendering their crystalline lenses more convex: a change which is only required by normal eyes when they are directed to near objects, and which also requires convergence of the optic axes. The ciliary muscles, or muscles of accommodation, which render the lenses more convex, derive their nerves from the same source as the internal recti muscles, which govern convergence; and the two functions are intimately connected together through the nervous centres. The flatness of the eyeball, a mere accidental malformation of an external organ, does not interfere with this intimate nervous connection; and hence the constant action of the muscles of accommodation, in a hypermetropic child, involves an equally constant action of the muscles of convergence, which become abnormally strong and habitually overpower their antagonists, so that the resting position of the eyes, or their position during sleep, is one of equal convergence instead of approximate parallelism. At the age when the child begins to look attentively at near objects he requires a still greater effort of accommodation in order to see them clearly, and in making this effort he makes a corresponding effort of convergence, with the result that, as his eyes start from a position of acquired convergence

instead of from one of parallelism, their convergence becomes greater than is necessary, and they are both directed to a point nearer than the object, so that double vision is produced. In order to see clearly, and to avoid the double images, the child renders one eye more divergent, so that it may be directed to the object; and, as the two axes have become combined in a relation of convergence, instead of in their original relation of parallelism, it follows that, when one of them turns outward to fix the object, the other turns inward in a greater degree than before. In Fig. 347 A and B represent a pair of hypermetropic eyes, which, by the constant action of their internal recti, have departed from their original state of parallelism when at rest, and are actually combined in a state of convergence, their axes, A C, B C, subtending equal angles with the imaginary line D C, drawn from the root of the nose into space. If the attention is directed to an object at E, a nerve-stimulus is applied which would have brought the optic axes from parallelism to the positions A E, B E, but which, as they start from a state of convergence, actually brings them to the positions A F, B F. The child then receives two images, neither of them on the yellow spot, and neither of them in the highest degree distinct. He is unable, by the action of both external recti, to overpower the stronger internal recti, and to direct both his eyes to the proper point without at the same time relaxing his accommodation, which he is bound to maintain. But he is able, by the action of one external and the other internal rectus, to turn both eyes together, as if they were structurally united. If he fixes the eye A upon the point E, the eye B moves together with A, turning inwards as A turns outwards, and directing its axis along the course B G. If he fixes the eye B upon the point E, the eye A moves together with B, turning inwards as B turns outwards, and directing its axis along the course A G. It follows that one eye looks at the point E, and sees it clearly, while the other looks at the point G, or towards the nose, and squints. It receives a false image of the point E, but upon so peripheral a portion of its retina that the double vision produces no inconvenience, and is neglected by the attention until it ceases to be an object of consciousness. If the acuteness of vision and the degree of flatness are alike in both eyes, and the external recti are of equal strength, it is a matter of accident which eye will be directed to the object and which towards the nose, and the squint will be alternating. But such equality of sight and of muscular power is not common, and the majority of children can direct one eye more readily than the other, or can see with it more clearly. When this is the case the employment of the best eye becomes instinctive—it is always directed to the object, and the squint becomes fixed. Under such circumstances the vision of the squinting eye often undergoes steadily progressive deterioration.

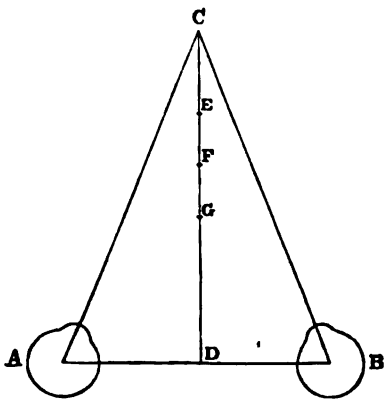


FIG. 347. Diagram to elucidate the mechanism of squint.

In a case of fixed squint, after a certain time, it is conceivable that the internal rectus of the squinting eye might undergo shortening, or that its external rectus might become atrophied, so that the faulty position would be

Secondary squint.

rendered permanent. Practically, this seldom occurs, and it is probable that the two eyes return to equal convergence during sleep, as they mostly do under the influence of an anæsthetic. In nearly all cases, if the working eye is closed or covered, the squinting eye can be made to fix an object correctly, just as if the squint were still alternating, and with the result that the working eye will deviate inwards, behind its covering, to the same extent that the squinting eye deviated before. The deviation of the working eye is called the secondary squint, and it is observed by screening the object from this eye by the hand, or some other opaque substance, over which the surgeon may look to observe the relative positions of the two.

When the secondary deviation of the working eye is equal to the ordinary deviation of the squinting eye we have proof that the squint is not caused by abnormal muscular weakness. A fixed convergent squint of the right eye may be produced by paralysis of its external rectus muscle, so that the internal rectus has no antagonist, and rolls the cornea inwards. If the paralysis is complete, the squinting eye will make no effort to fix the object when the working eye is covered, because the former has no power of abduction or outward rotation at all. If the external rectus is only weakened the squinting eye will, indeed, turn outwards when the working eye is covered, but with an effort more or less feeble, and the working eye will deviate inwards in a still greater degree. The reason is that the central nerve-ganglia of the external rectus of one eye and of the internal rectus of the other are in intimate relation, for the purpose of turning both eyes right or left by a consentaneous movement; and hence, in the case supposed, the external muscle of the squinting eye and the internal muscle of the working eye would receive equal motor impulses at the same moment. The weakened muscle of the squinting eye would respond feebly, the healthy muscle of the working eye would respond naturally; and the eye which was moved by the latter would make a larger excursion than that which was moved by the former. Hence it is only when the secondary deviation of the working eye is equal to the primary deviation of the squinting eye that we have to deal with uncomplicated strabismus; and whenever the squinting eye has lost its power of fixation, or when its movement for that purpose is attended by a still larger movement of its covered fellow, the squint is either caused or complicated by paralysis, in the former case complete, in the latter incomplete, of the physiological antagonist of the muscle by which the deviation is produced.

Treatment. The effort of accommodation on which squint is primarily dependent could be theoretically rendered unnecessary by convex spectacles, But the effect upon the convergence muscles is usually produced at so early an age that spectacles could not be worn in time to be useful. When squint is fairly established, spectacles, although they may diminish, will fail to cure it; and a variety of ingenious endeavours to restore parallelism of the eyes by stereoscopic exercises, exercises with prisms, and other like contrivances, have not been attended with such a measure of success as to encourage their adoption in any but exceptional instances. When the sight of both eyes is good, and the squint is uncomplicated by paralysis, it is always curable, not only coarsely, and so as to correct a manifest deformity, but perfectly, so as to restore harmony of position and movement under all circumstances, by a well-planned and skilfully-performed operation or operations. As long as the squint is alternating the operation may be postponed without injury; but as soon as the squint is fixed it should be performed without delay in order to prevent impairment of the vision of the squinting eye. In very

young children, under such circumstances, it is often best to be content with a somewhat coarse correction, and to leave the final operation to a later period. The surgeon may always say that the result is absolutely under his control, but that in order to obtain perfection he must be permitted to operate twice, or even thrice if necessary.

Objects of the operation.

The immediate object of each squint operation is to separate the tendon of the internal rectus muscle from the sclerotic, with the least possible disturbance of surrounding parts, so that the muscle may form a new attachment posterior to its original one, and may produce by the same effort of contraction a smaller degree of convergence than previously. The final object of all the operations which may be necessary is to place the optic axes in a position of approximate parallelism, with only the normal slight inclination to convergence when the eyes are at rest, and to do this without any impairment of the power of volitional convergence, which should be left available for directing both eyes equally to any near object, and for maintaining this direction as long as it may be required.

Considering that squint is always a binocular affection it is obvious that a perfect result can seldom be expected from an operation on one eye only. If the degree of deviation is not large, such an operation may produce parallelism when the eyes are at rest, and may correct a conspicuous deformity, but it can only do so at the cost of producing a permanent difference of convergence-power between the two, so that a common motor impulse would affect them differently, and the eye operated upon would lag behind the other during every effort to direct both to some near point. Fig. 848 represents a pair of eyes, A, B, in the ordinary position of fixed squint. At rest—that is, during sleep—they would be equally convergent, but the working eye, A, is habitually directed forward, for visual purposes, along the line A A′, and the whole convergence is manifested by the squinting eye B, which is habitually directed inwards along the line B B′, these two lines forming always an angle of the same magnitude. The internal recti muscles of the two eyes are inserted into the sclerotic at the points C C′. Let it be supposed that an operation upon the eye B, which put back its internal rectus to a new attachment at D, would overcome the habitual convergence, and would allow the line of direction B B′ to become parallel to the line of direction A A′. When the eyes were directed forwards the squint would be cured, but the internal rectus of the eye A would be left in a position of advantage, with its strength undiminished, while the internal rectus of the eye B would be weakened by being placed in a position of great disadvantage. When any attempt was made to fix both eyes on a near object the same central motor impulse would produce different results upon the two, and the eye B would either lag behind the other and appear to squint divergently in relation to it, or its muscle would become tired and strained by being called upon for a greater exertion than its fellow. The proper operation is to divide the correction equally between the two eyes by putting back the two muscles to the points of attachment E E′. By this we not only obtain parallelism when the eyes are at rest, but leave them with equal and

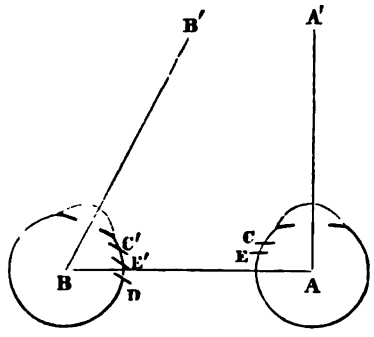


Fig. 848. Diagram to illustrate the operation for strabismus.

sufficient convergence-power, and replace them in that natural condition from which they had been caused to deviate by the acquired hypertrophy of their internal recti muscles.

Magnitude of a squint.

The magnitude of a squint is commonly expressed by the distance between two vertical lines, one of which bisects the palpebral opening of the squinting eye, while the other bisects the pupil of the same eye when the working eye is directed forwards, as shown at A and B in the figure. It is obvious, as tenotomy of the internal rectus cannot be made to produce less than a certain minimum of effect, that a squint may be so small as only to admit of a single operation, which should then be performed upon the squinting eye; and it is also obvious that a squint may be so large that no single operation can correct it. In former times, when neither the etiology nor the binocular character of the affection was understood, it was customary in such cases to perform the second operation on the same or squinting eye, and some very hideous deformities were occasionally thus produced, the displaced muscle ultimately losing all power over the globe, and permitting its inner side to project in an unsightly manner, while the cornea was directed outwards. It is now understood that if a first operation upon the squinting eye produces only partial correction, the second operation must be performed upon the working eye, even although it is the other which still squints. The affection remains a binocular one, although it falls upon the eye which has the least useful vision, and parallelism will be restored by operating upon the other. When a squint is very large it is admissible to operate upon both eyes at once; but when it is only of moderate dimensions it is more prudent to defer the second operation for two or three months, until the muscle first divided has entirely regained its power.

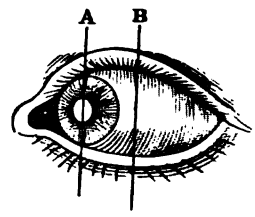


FIG. 349. Diagram to show the method of estimating the degree of squint.

Details of operation.

For the performance of the operation the patient should be recumbent upon a narrow couch and fully etherised. The surgeon stands on the right hand side of the patient, and, having separated the lids by a speculum, pinches up with forceps a vertical fold of conjunctiva and subconjunctival tissue at a point where the inner vertical and the lower horizontal tangents to the cornea would intersect each other. With a pair of fine scissors, pointed and curved on the flat, he divides this fold to its base immediately below the forceps, and gives an additional snip, to be certain that he has cut quite down to the sclerotic, making a horizontal wound. Retaining his hold with the forceps, he places the extremity of a strabismus-hook (Fig. 350) on the exposed sclerotic, runs it a little down, to be sure of getting beneath the tendon, well back, to be sure of getting behind it, and then upwards and forwards in a bold curve, the extremity of the hook never losing touch of the surface of the eyeball. When this manœuvre is properly executed the extremity of the hook shows under the conjunctiva above the upper margin of the tendon, and the curved part is completely concealed from view by the body of the tendon, and is checked by it from advancing to the corneal margin. If the whole of the hook can be seen through the conjunctiva, or if it can be pulled up to the corneal margin, it is not under the tendon at all, and another sweep must be made. When the hook is rightly placed the operator shifts it into his left hand, and takes the scissors in his right. He makes steady traction with the hook towards the outer canthus, holds the

scissors very slightly open, with their curve corresponding to that of the hook, introduces them into the wound, and passes the lower blade under the tendon in contact with the convexity of the hook, which serves as a director, while the point of the upper blade is insinuated between the conjunctiva and the tendon, just making its own track through the subconjunctival connective tissue. When the scissor-blades include a third or a fourth of the width of the tendon they may be closed, then opened and pushed on for another snip, and so on until the whole of the tendon is divided, when the hook, no longer held back against the traction of the operator, will at once break through the connective tissue and advance to the corneal margin. The operation is then completed.

Sutures.

In a general way the wound requires no treatment, except the application of cold or iced water to the lids if there is sufficient tendency to bleeding to threaten a disfiguring ecchymosis which would be only slowly absorbed. In the case of a second operation, if there is any fear that too great an effect has been produced, the retraction of the muscle may be checked by the insertion of a deep suture to draw it forwards towards the cornea. If the original wound was a little large, or if any vertical cut has been accidentally made in the conjunctiva, a fine suture should be passed through this membrane only. A suture should also be applied if the cut edge of the tendon is exposed in any part of the wound, as otherwise a fleshy prominence is apt to spring up in such a place and to be a source of disfigurement. If such a prominence should form it may be snipped off close to the conjunctiva, and the cut surface may be touched with nitrate of silver, after which all trace of the swelling will disappear.



Fig. 350. The strabismus-hook.

Paralytic strabismus.

When strabismus is not produced in the ordinary way, but is a result of paralysis, as shown by the secondary squint being larger than the primary, the case will in the first instance require treatment addressed to the paralysis itself. But if this should prove ineffectual a perfect cure may often be produced by tenotomy of the contracted muscle, followed by daily localised faradisation of its weakened antagonist. The electricity should be applied by a pair of very fine conductors to the conjunctiva covering the affected muscle.

Divergent strabismus.

Divergent strabismus is comparatively seldom met with, although it sometimes occurs as a result of over-correction of the convergent form, sometimes as the result of the mere wandering outwards of an eye which has lost vision, and occasionally from weakness of the internal recti muscles. It is scarcely ever sufficient to perform tenotomy of the external recti, but in most cases the internal recti must be shortened or brought forward to an attachment nearer to the cornea. For this purpose the internal rectus of the affected eye must be separated from its attachments, a portion of its tendon cut off, and the rest brought forward by two sutures, one of them taking in a broad piece of the upper portion of the conjunctiva, the other of the lower. The muscle should be exposed, for this purpose, by a horizontal incision from the margin of the cornea to the caruncle, but no conjunctiva should be taken away. Division of both external recti will generally be necessary. Such operations are chiefly performed for the improvement of appearance, and they require to be carefully planned and skilfully executed

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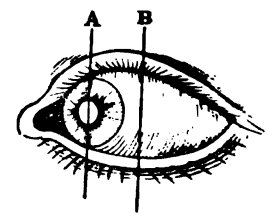


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in order that they may not do harm rather than good. It is better that they should not be undertaken by any surgeon who has not had opportunities of gaining experience of the general effect of displacements of the ocular muscles, as it is very easy to do either too little or too much. In the former case the patient will be unconscious of benefit, in the latter he will often have much reason to complain.

Recent paralysis of ocular muscles.

In cases of recent paralysis, or weakening of one or more of the ocular muscles, double vision is always a prominent and often a distressing symptom; although the degree of deviation of the eye may be extremely slight. When paralysis attacks the third nerve, which supplies the levator palpebræ, the sphincter of the pupil and the muscle of accommodation, and all the external muscles of the eye, except the external rectus and the superior oblique, the effect produced is very remarkable. The upper lid falls completely, and cannot be raised by any effort of the will. When it is raised by the surgeon it shows the pupil dilated, the eye somewhat abducted, but capable of being carried further outward by an effort, and immovable in other directions. When paralysis attacks the sixth nerve, only the external rectus muscle is affected; the eye is adducted, and there is double vision of all objects towards its temporal side, but not of objects situated on its nasal side. In some cases the third nerve is only partially affected, the muscles supplied by certain twigs entirely escaping; and in all cases the position of the eye and of the false image are not the direct results of the paralysis, but the final results of the re-arrangement of a group of forces from which certain members have been taken away, so that the balance of the whole group is disturbed.

Determination of the deviating eye.

When the amount of deviation of the affected eye is very small, it is not always easy to determine which of the two is at fault; but the most simple test for this purpose is to desire the patient to look fixedly at an object, and then to conceal it, first from one eye and then from the other, by the interposition of a screen over which the movements of the eye may be watched. When the screen conceals the object from the unaffected eye the deviating eye will instantly move to fix it; but when the screen is placed over the deviating eye the other remains motionless. Again, if the patient keeps his head still, and follows with his eyes any object which is moved to and fro, up and down, and laterally, the observer can hardly fail to detect a loss of mobility in some direction. Lastly, the test with red glass already mentioned will determine to which eye each image belongs.

Causes of paralysis.

Paralysis of a single cranial nerve, producing paralysis of one or more of the muscles of the eye, may be due to various kinds of lesion, but in probably half the cases in which it occurs it is due to the cropping up of some late form of syphilis; either to gummatous tumour in the nervous centres or to pressure on a nerve-trunk from periosteal deposit. The mere fact of paralysis of the sixth nerve, or of the fourth, throws no light upon its cause; but paralysis of all the branches of the third is presumably due to some cause of pressure acting upon the common trunk in which they are combined prior to distribution, while paralysis of single branches is presumably due to some cause acting upon one or more of the scattered ganglia of origin. On the same principle, if two or more of the nerves entering the orbit are affected, there is at once reason to suspect pressure from periostitis at the sphenoidal fissure, where the trunks are contiguous to one another. Besides gumma and periostitis, paralysis of one or more of the orbital nerves may be produced by various forms of disease or degeneration of the nervous centres, and also by injuries of the head. There was for some time

in St. George's Hospital a girl who received a severe blow on the parietal region, and in whom, after the lapse of some months and the subsidence of other symptoms, paralysis of the superior and inferior recti on the injured side remained, although the other muscles supplied by the third nerve were unaffected.

Treatment.

In every case of paralysis of an ocular muscle the surgeon must seek any guidance as to the cause which can be obtained from the history and the other symptoms of the patient; and must especially endeavour to satisfy himself with regard to the presence of syphilis. Unless the results of his examination point definitely to some other mode of treatment he will generally do well to give iodide of potassium, and to give it in doses frequently increased to the fullest extent which can be borne; commencing with ten grains three times a day, and proceeding to double or treble that quantity. In all cases of disease of the nervous centres produced by late forms of syphilis the iodide will alleviate the existing symptoms, and if sufficiently pushed will remove them in a very remarkable manner; but it seems to have no influence in preventing the recurrence of syphilitic mischief in some other form or in some other organ. Whenever, therefore, paralysis of a cranial nerve has yielded rapidly to the iodide, there is a *primâ facie* reason for a course of perchloride of mercury, or for some other method of mercurial treatment, in the hope that by its means the constitutional taint may be removed. In some cases, when the nervous affection has been relieved, the muscular paralysis remains, because the muscle, weakened and wasted by a period of inaction, is no longer able to strive against its physiological antagonist. Under such circumstances benefit may be derived from localised faradisation of the weak muscle, and, if this should not prove sufficient, the tendon of the contracted muscle may be divided.

By iodide of potassium.

By mercury.

By electricity and tenotomy.

Diseases of the lacrymal apparatus. Epiphora.

The lacrymal apparatus is often the seat of derangements which call for the interference of the surgeon. Most of these derangements are attended by an overflow of tears, either from excess of secretion or from some impediment to its removal, and such overflow has received the general name of 'Epiphora,' independently of the causes which may produce it. The lacrymal glands may become hypertrophied and may require removal, or they may be removed on account of inveterate obstruction of the nasal ducts. The operation is easily performed through an incision immediately below the outer two-thirds of the margin of the orbit, but care should be taken to make this incision sufficiently long. The lacrymal gland often has appendages at some little distance from its main body, and any one of these, if left behind, will continue to discharge its secretion through its divided duct into the surrounding tissue, producing troublesome swelling which may end in abscess. The lacrymal puncta are sometimes occluded, and may be seen by a magnifying-glass as little prominences with no central apertures. Or the canaliculi may be occluded between the eye and the lacrymal sac, a condition which can only be discovered by the passage of a very fine probe, sufficiently fine to pass through the punctum itself. It must be remembered that the punctum constitutes a short vertical channel placed at the extremity of the horizontal canaliculus, which joins it at a right angle; and it is necessary in any attempt to pass a probe to remember this right angle, and to convert it into an obtuse one by drawing the eyelid, generally the lower lid, outwards, and fixing it by finger-pressure while the probe glides round the little corner and straightens out the channel. Once within the canali-

culus, the probe should pass on without encountering resistance until it crosses the lacrymal sac and is arrested by bone. If the canaliculus is obstructed the resistance may be felt by the fingers, and the eyelid may be seen to be moved by the probe. Obstructions of the puncta or the canaliculi are scarcely worth treatment, so prone are they to reunite, and so trifling is the inconvenience which they occasion.

Obstruction of the nasal duct.

Obstruction of the nasal duct below the lacrymal sac is a much more formidable and troublesome affection. It may commence at any period of life, from early childhood to old age, and is generally attributed to some cause with which it has no intelligible connection. The first symptoms observed are that tears lodge and overflow, and that a small colourless elastic tumour appears at the inner corner of the lower eyelid. This tumour is the distended lacrymal sac, which becomes filled with tears until no more can enter. By pressure with the finger it can be emptied, and its contents, which consist at first of tears more or less inspissated, can be squeezed back into the conjunctival sac through the puncta. After a time the tear-bag becomes irritated by distension, and its lining membrane secretes a quantity of mucus, which mingles with the tears and can be pressed out with them. Either by the mere continuance of the irritation, or by some accidental increase of it, a state of actual inflammation is produced, and the secretion becomes purulent. The swelling of the lining membrane closes the only outlet, and the result is an abscess which discharges itself upon the cheek by an opening which is prevented from healing by the continual discharge of tears through it, and which becomes a lacrymal fistula. When the fistula is established the irritation often subsides, leaving only a minute hole, through which a drop of clear fluid now and again exudes, and which is surrounded by a more or less reddened, encrusted, or unsightly margin. But even then a small matter will excite fresh mischief, and will render the secretion of the sac once more profuse and purulent.



Fig. 351. Weber's canaliculus-knife.

Treatment.

Excepting, perhaps, in a few persons of more than ordinary irritability, the train of evils above described is only produced by over-distension of the tear-bag, and may be prevented by keeping it emptied by pressure. In children it is never desirable to operate unless abscess is imminent;

By pressure.

and many adults live in perfect comfort by the simple precaution of squeezing out the contents of the little tumour every half-hour or so, a habit which soon becomes a second nature. If this habit has not been acquired or has been broken through, and if the lining membrane of the sac is becoming irritable, as shown by a little tenderness on pressure, by the character of the secretion, and by redness or swelling of the conjunctiva near the puncta, and of the caruncle and plica semilunaris, it is well to endeavour to cure the stricture by passing through it a full-sized lacrymal probe, of one of the well-known patterns, but preferably with a bulbous extremity. Such a probe is too large to pass through the punctum or the canaliculus, and they must be slit up to make room for it. The best instrument for this purpose is Weber's canaliculus-knife (Fig. 351),

a keen narrow blade terminating in a short, smooth, and rounded beak. Drawing the lower lid outwards, and rendering it tense, the surgeon passes the beak through the punctum, carries it carefully round the angle into the canaliculus (with the cutting edge upwards), and pushes it horizontally onwards until its beak is arrested by bone. Still keeping the lid tense, he raises the knife to a vertical position, and in doing so lays open the punctum and the canaliculus quite up to the lacrymal sac. Along the groove thus formed he introduces a probe in a horizontal direction until it also is arrested by bone, and then, keeping touch of this bone as far as possible—

By probing.



Fig. 352. Stilling's knife for dividing lacrymal fistula.

that is, not withdrawing the probe in the least—he raises it into a vertical position, so that it may cross the supra-orbital notch, and that its extremity may with a little care be engaged in the upper orifice of the nasal duct. The probe is then pushed down, and through the stricture (which may sometimes offer a considerable, though elastic, resistance), until its extremity rests upon the floor of the nose, when it should be left in position for a few minutes and then withdrawn. For the first few days the lips of the incision along the canaliculus must be separated daily, until they have lost their original disposition to unite, and the slit is rendered a permanent one. After an interval of from three days to a week, according to the pain suffered and the degree of local irritation, the probe may be passed through the stricture again, and it should encounter less resistance than before. In order to modify the chronically inflamed state of the mucous membrane of the sac, an astringent lotion, say of five grains of acetate of lead to an ounce of water, should be dropped into the inner canthus every three or four hours, the sac having first been thoroughly emptied by pressure, and the original probe, or preferably a still larger one, should be passed every few days for three or four weeks. It may then be laid aside, and only the lotion continued, with the result that, in favourable cases, the stricture will remain pervious, the secretion of the sac will return to its normal character and quantity, and the tears will be carried into the nose by the natural channel.

Relapsing cases.

A result so favourable as this is by no means the rule, and in a certain proportion of instances the stricture will again become impassable and the old troubles will be renewed. The surgeon may then have recourse to division of the stricture, for which purpose he first passes a probe through it as before, and then, withdrawing the probe, replaces it by Stilling's knife (Fig. 352), which is introduced in the same manner, and which is made to divide the stricture radially, from the centre to the walls of the nasal duct, in three or four directions, until the blade is quite free and loose in the duct, and blood escapes from the corresponding nostril. Nothing more need be done, and a complete cure will sometimes follow. Too often, however, the stricture again contracts, and then the cases fall into two classes—those in which the patient can keep himself tolerably comfortable by frequently emptying the sac and by the use of an astringent lotion, and those in which the sac is often inflamed and the eye constantly irritable. Many attempts

have been made to cure cases of the latter class by repeated probing, by leaving short probes in the duct, by the use of probes of a material which expands by the absorption of moisture, when introduced, and by applying lotions directly to the duct with a syringe. I have not seen any of these methods produce results at all equivalent to the disadvantages which attend upon them, and in the bad cases it is probably the best practice, either to remove the lacrymal gland or to destroy the diseased sac with caustic. The former operation has already been referred to; the latter is performed by making a vertical incision through the cheek into the sac, so as to open its whole length. Bleeding having been arrested, and all secretion removed, the sac may be filled with a pellet of cotton-wool charged with chloride of zinc paste, and the whole sac will in due time be thrown off as a slough. Care must be taken to protect the cheek, by plaster or oil, from the action of the caustic; and it will often happen, during cicatrisation, that the tears will maintain for themselves a passage through the tissues by which the sac is replaced. After extirpation of the gland the conjunctiva is moistened only by its own secretion; and the sac, no longer irritated by tears, returns gradually to a healthy condition.

If the patient, when first seen, has actual abscess of the lacrymal sac, an attempt should be made to prevent yielding of the skin by opening the abscess through the canaliculus. The cavity should be kept empty by frequent gentle pressure, but no attempt should be made to pass a probe through the stricture until all acute irritation has subsided. If fistula lacrymalis has actually been formed the stricture must be treated in the manner already described, and, if it can be treated successfully, the fistulous opening will close so far as to be imperceptible.

The uses of spectacles.

It still remains to speak of the uses of spectacles, a large and somewhat complicated subject, which, in the space available in this volume, can only be treated in the most superficial manner. It may be laid down as a general principle that spectacles are required in almost every case in which there is good vision under some circumstances but not under others—good vision limited by some conditions of space or of time. The only notable exception is in cases of night-blindness, which depend either upon pigmentary retinitis or upon exhaustion of the retina by exposure to excessive illumination. But, roughly speaking, if vision is conditioned by space, so that a person can see clearly only within a certain limit of distance, or only beyond a certain limit of distance, or if it is conditioned by time, so that a person can see clearly for a certain period of effort, but no longer; or if it is conditioned by the shape or direction of objects, as when horizontal lines are seen more or less plainly than vertical ones, in all such instances spectacles will alleviate or remove the defect. The fact that there is good vision at any time, or under any circumstances, proves that the retina is healthy and the sensorium receptive; so that the defective vision under other circumstances can only be due to some imperfection of the muscular apparatus of vision by which the eyes are adjusted and directed to the object. Moreover, the occurrence of pain, aching, or straining, which is not constant, but which is brought on only by using the eyes, and is relieved by resting them, may generally be taken to indicate that nothing but the muscular system is in fault, that there is no organic disease or serious defect, and that optical assistance is all that is required.

The eye of natural shape and proportion is said to be 'emmetropic.'

Emmetropia signifies that the eye, when in a state of absolute rest, sees distant objects clearly. Its vision is bounded by no far point, but extends theoretically to infinity, and practically takes in the fixed stars. In order that such an eye may see near objects clearly the convexity of its crystalline lens must be increased; and the nearer the object approaches the greater the convexity must become. This change is brought about by the action of the ciliary muscle, or muscle of accommodation; and, as the power of the muscle is limited, the extent to which the convexity of the lens can be increased is also limited, and clear vision is limited by a 'near point,' nearer than which objects cannot be seen distinctly. The state of the eye at rest is called its 'refraction;' the power of altering the refraction to see near objects is called 'accommodation.' Emmetropia.

While the muscular power available for accommodation is always about the same, the plasticity or elasticity of the crystalline lens diminishes from childhood onwards, and it becomes every year harder after the age of about eleven. Consequently, after that age, the near point goes farther away from the eye every year, as the power to mould the shape of the lens diminishes. A child of eleven might read small print at four or five inches, but the same person at the age of twenty would not be able to read it nearer than at six or seven inches. As years increase, the accommodation diminishes in an increasing ratio, until, at forty-five or fifty years of age, the near point is so far away that a book or newspaper can only be read when it is inconveniently remote, so that the eyes hardly receive sufficient light from it. This state is called aged sight, or presbyopia, and it is a natural and physiological condition, common to all healthy and well-formed eyes. When it occurs prematurely it may be a sign of premature senile decay; and when it increases very rapidly it may be premonitory of glaucoma. But at the average time, and in the average degree, it is simply the common lot of humanity, from which only people who were originally shortsighted are even apparently exempt. Presbyopia.

Presbyopia is in its essential nature incurable, but its effects are entirely obviated by convex spectacles, which produce outside the eye the same optical effect which the wearer is no longer able to produce by an internal effort. Presbyopic persons should wear spectacles as soon as the defect makes itself felt and should not be tempted by spectacle-sellers to begin with insufficient power. The use of glasses will save them from much straining and effort and will restore them to juvenility of vision. Comfort in use is the best test of efficiency, and no glasses that are comfortable in use will ever do mischief. Glasses for presbyopia.

The essential condition of emmetropia is that the focal length of the crystalline lens should be equal to its distance from the retina; or, supposing the lens to be an invariable quantity, that the eyeball should be of a certain depth from front to back. It is obvious that this condition may be departed from in two opposite directions—by the eyeball being too short from front to back, or by its being too long. An eye in either of these conditions is distinguished as being ametropic, and ametropic eyes fall naturally into two classes—the hypermetropic, which are too short from front to back; and the hypometropic, or myopic, which are too long. In the annexed diagram the dark line represents emmetropia, or the normal standard; the inner dotted line represents hypermetropia; the outer dotted line represents myopia. Ametropia.

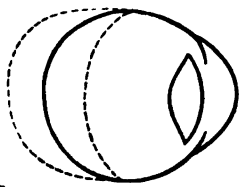


FIG. 353. Diagram of emmetropia, myopia, and hypermetropia.

Hypermetropia.

Hypermetropic people have conditioned vision. They do not see anything clearly when their eyes are at rest, and hence they instinctively exert accommodation, more or less, according to the degree of their defect, even for distant objects. For near objects they require, of course to accommodate still more. In childhood they are liable to squint, and at all ages they are apt to find the use of their eyes excessively wearisome. Employment over minute objects is apt to produce intolerable aching. The intensity of these symptoms is determined by three elements—the degree of hypermetropia, the flexibility of the lens, and the strength of the muscle of accommodation. When the degree is slight, and other circumstances are favourable, hypermetropia may appear only as early presbyopia, calling for glasses at thirty-five or forty years of age, independently of premature senility. When the degree is high, and circumstances are unfavourable, the result may be absolute incapacity to use the eyes for sustained looking at any near object.

Glasses for hypermetropia.

Hypermetropia, in its extreme degrees, is a malformation which partakes of the nature of an arrest of development and which is often associated with an imperfect sensitiveness of the retina. Except for this it is entirely relieved by convex spectacles; and whatever the degree of sight all pain or discomfort may be removed by resting the accommodation by their employment. The spectacles should be worn constantly from morning to night, so that the eyes are never called upon for abnormal effort, and their strength should be exactly compensatory of the defect. How to ascertain the necessary strength may be found in systematic treatises upon the subject. For the purposes of this volume it is sufficient to point out that the pains of hypermetropia require and may be cured by spectacles, and that they do not require and cannot even be improved by the energetic medical treatment which they sometimes receive.

Myopia.

The opposite condition, myopia, is the physical cause of short sight in which vision is limited by some finite 'far point.' The far point may be six inches from the eye or twenty-four inches, or six feet, but wherever it is there is no clear vision beyond it. The evil results of myopia are two in number: first, that it prevents those who suffer from it from seeing the world, and thus greatly curtails the unconscious education which the world imparts. Next, in its high degrees, by requiring the two eyes to be maintained in a high degree of convergence in order to direct them both to a near object, it throws a mechanical strain upon the posterior part of the hemisphere, which leads to its mechanical elongation, with consequent increase of the myopia, and which leads also, in many cases, to atrophy and even to chronic inflammation of the choroid, and to subsequent changes which are destructive to sight. Hence it is important that myopic children should constantly wear spectacles which will enable them to see the world in which they move, and it is still more important that they should wear spectacles which will keep their books and their work away from them—which will not, indeed, enable them to see better, but will compel them to see farther off. Such spectacles must be concave, and whether or not the same pair will fulfil both purposes will depend upon the degree of the defect. How to measure this degree, and how to prescribe for it when it is ascertained, are points on which information must be sought elsewhere.

Astigmatism.

There is also a complicated form of ametropia called astigmatism, in which the cornea, like the bowl of a spoon, is differently curved in two directions which are at right angles to each other, and sometimes, but not

always, vertical and horizontal. The possible combinations of astigmatism are very numerous, but the general test of its presence is that similar lines are seen more or less clearly according to their direction. Even more than hypermetropia it is a source of fatigue and distress which disqualify the eyes from exertion; but it admits of being greatly relieved by glasses with cylindrical surfaces, which refract more in one direction than in another, and which must be carefully calculated to meet the peculiarities of every case.

Powers and nomenclature of spectacles.

The whole of the defects included under the terms presbyopia and ametropia are expressed as regards their degrees, in terms of the spectacles which relieve them; and the nomenclature of spectacles has recently undergone an important change in the direction of simplicity. Formerly, the powers of glasses were expressed by their focal lengths in inches, and a glass of one inch focal length was taken as the unit of the series, so that lower powers were parts of this unit and had to be treated as fractions in all the calculations based upon them. Under the new nomenclature, the unit is a lens which has a focal length of one metre or forty English inches, and all those in common use, instead of being parts of the unit, are multiples of it, and may therefore be treated as whole numbers. The unit itself is called a diopter, and the power of any lens is stated by the number of diopters to which it is equal. Thus, a lens of twenty inches focal length, which is twice the power of a diopter, is called a lens of two diopters, or No. 2; and a lens of ten inches focal length is one of four diopters, or No. 4. To find the number of diopters, in any case, it is only necessary to divide forty by the focal length in inches, and the result will give the power of the lens in the new nomenclature. This process will only be necessary for a time, during a period of transition; for people will soon learn to think of lenses in diopters, and to lay aside the cumbrous inch nomenclature entirely. The new series has the additional advantage that all its intervals are alike; and, in the case of the weaker glasses, these intervals are diminished by the introduction of half and quarter diopters into the scale. Test cases upon this principle are now manufactured, and may be obtained from almost all opticians. In writing, convex glasses are distinguished by a plus (+) and concave glasses by a minus (−) sign.

CHAPTER XXXVI.

DISEASES OF THE EAR.

THE present chapter is only intended as an indication of the chief topics in aural pathology and therapeutics; as an auxiliary to the understanding of a very difficult and complex subject, and an introduction to the study of special treatises.

The most intelligible, and I think for practical purposes the most useful, division of the diseases of the ear is into those of the external meatus, the membrana tympani and tympanum (including the Eustachian tube and mastoid cells), and the labyrinth. And it may be said, I think with truth, that most of the affections of the external parts are curable, many of those of the tympanum very difficult of cure, and all those of the labyrinth at present inaccessible to treatment.

Malformations of the auricle.

Malformations, such as imperfect development of the external parts, absence of the meatus or supernumerary auricles, are every now and then met with. They are interesting in a scientific or morphological point of view, but of little surgical importance. Supernumerary auricles should be removed when it will improve the patient's appearance; for the other malformations no treatment can be recommended.

Hæmatoma auris.

A blood-tumour (hæmatoma auris) is often met with in the auricle in insane persons. It is not usually necessary or desirable to meddle with it.

Keloid and other tumours of the auricle.

If it threatens to grow large it should be treated by setons. Other tumours form in the auricle, the most familiar being the little fibrous or keloid tumour which sometimes grows around the puncture of the earring in ladies. When this is really increasing, or when it has attained a size which produces disagreeable deformity, it should be removed; but the operation is rarely necessary. When it is so, the best plan is to cut out the tumour by a V-shaped incision, and bring the parts together at once.

Cysts, gouty deposits, and fatty or other innocent tumours are found occasionally in the auricle, but their treatment presents no peculiarity.

Eruptions.

The most common affections of the auricle are the pustular or vesicular skin-eruptions, eczema, herpes, impetigo, and the chronic inflammation which occasionally follows on erysipelas. The chief differences in the pathology and treatment of such affections from those which occur in other situations depends on the difficulty of keeping the ears clean and dry, and on the liability to accumulation of secretion in the recess of the meatus: scrupulous attention to these points will generally render these diseases much more tractable. The general health and the state of the secretions must be carefully attended to, and the diet and medical treatment regulated accordingly; the auricle must be carefully cleansed and dried twice a day, and the meatus well syringed out with warm water or any appropriate lotion, after which the local application which is indicated in each skin-eruption is to be applied (see DISEASES OF THE SKIN). In the chronic erysipelatous inflammation lotions of nitrate of silver will be most serviceable.

The periosteum of the external meatus is sometimes inflamed, leading to an acutely painful swelling, which after some time may suppurate. It is not

necessary, however, to wait for the formation of matter in order to open the swelling. A free incision will relieve the patient's sufferings and may avert further mischief. Otherwise the bone itself may become carious; and although this disease is less alarming than that which affects the parts of the bone nearer to the vessels and membranes of the brain, yet it is very tedious, threatens permanent damage to the hearing, and may spread inwards. Periostitis and caries of the external meatus.

The examination of the external meatus is directed to ascertain the condition and appearance of its lining membrane, the presence or absence of foreign bodies, or of accumulations of wax, and the condition of the membrana tympani. In a very good light the tympanic membrane can sometimes be seen without a speculum; but usually a silver tube, either solid or cleft and dilatable, is necessary, and unless bright daylight is available it is necessary to throw the light of a lamp with a reflector behind it down the tube. The best light is bright daylight reflected from a mirror with 8-inch focus. In operative procedures a similar mirror should be worn on the forehead (as in laryngoscopy), in order to leave both hands free. Mr. Hinton says that in the case of very young children the speculum is to be used with caution, on account of the shallowness of the meatus. 'The points to be noted in the examination of the meatus are the size and calibre of the canal, whether normal or infringed upon; the presence or absence of extraneous bodies and cerumen, and the condition of the lining membrane.' Examination of the external meatus and membrana tympani.

Accumulation of cerumen is a very common cause of deafness, and often induces giddiness and various still more unpleasant symptoms. It may even cause absorption of the bony walls of the meatus. The suddenness of the deafness, the presence of other catarrhal symptoms, and the variability of the power of hearing, often mark the deafness following on sudden accumulation of wax arising from catarrh of the meatus, even before examination. The wax must be removed by constant and liberal syringing with warm water. The patient sitting with his head inclined over a basin, a stream of water is to be directed out of a syringe holding about five ounces along the roof of the meatus, running out below. Softening the wax with alkaline solutions or warm oil dropped into the ears at night will promote its discharge. Often a large mass comes away at last, presenting a complete cast of the meatus, and leaving the lining of the meatus irritable. Soothing applications and repeated syringing if the wax re-collects are then required for some time. The irritability depends, in part at least, on removal of the epidermis along with the wax. Accumulation of wax.

Another common affection of the meatus is inflammation of its lining membrane, sometimes leading to abscess. Chronic inflammation of the meatus is one cause of otorrhœa, but only one out of many; and before putting otorrhœa down to that cause the membrana tympani must be carefully inspected. If it is healthy and the disease obviously proceeds from an inflamed condition of the lining of the meatus, the next thing to determine is whether this is merely catarrhal or depends on any constitutional cachexia; of which struma and gout are the most frequent. Any such cachexia having been combated, warm syringing and warm fomentations to the inflamed membrane are indicated, with leeches and morphia if there is much pain. When the acute stage has subsided mild mercurial ointments, or a solution of nitrate of silver five or ten grains to the ounce, should be applied on a camel's-hair brush. Otorrhœa.

In some cases the disease becomes chronic, and the cuticular lining may desquamate from the whole meatus, like the finger of a glove. But in these instances Mr. Hinton says there is almost always disease of the deeper structures. When abscess occurs in the meatus a free and early opening is essential.

Syphilitic affections.

Syphilitic condylomata, or secondary ulcers, may form around the meatus. They are rare, but the surgeon ought to be alive to the occurrence of such symptoms, in order to diagnose them, by the investigation of the other parts of the body and by the history.

Tumours of the meatus.

The tumours of the meatus are polypi, sebaceous tumours, and exostoses. Polypi usually have their seat further inwards, and will be afterwards spoken of. Sebaceous tumours also often grow into the meatus from the tympanum. Their continued growth may cause absorption of the base of the skull and fatal irritation of the brain. It is not easy to recognise them from accumulations of wax. The treatment consists in puncturing the swelling, removing the accumulation of epidermal scales by syringing, and if any distinct investing membrane can be recognised drawing it out with the forceps.

Exostoses.

Exostoses, so-called, occur in comparatively early life, and seem often only periosteal deposits, so that 'treatment is not so inefficacious as might have been feared.' The appropriate treatment consists in local depletion and counter-irritation with mercury or iodine internally. If wax is retained behind the tumour much patience and dexterity may be necessary to remove it. In other cases small ivory exostoses spring from the bony meatus, sometimes symmetrically on both sides and occasionally two or three in number. When single the growth of these tumours is believed to be connected with the irritation of discharge from a diseased tympanum. It may then be necessary to remove the exostosis, but its density renders this difficult. Mr. Dalby recommends a dentist's drill, to be manipulated by an assistant and controlled by the surgeon, the meatus being illuminated by the frontal mirror.

Examination of the tympanum.

The membrana tympani, when seen in a healthy ear, 'reflects light strongly, and owing to its peculiar curvature presents a bright spot of triangular shape at its lower and anterior portion.' The white streak formed by the handle of the malleus can usually be seen running vertically down it.

Perforation of membrana tympani, from injury or disease.

The examination is directed to ascertain, first, the presence of perforations from injury or disease. Such perforations may be caused in a healthy membrane by a blow or a loud report, or a wound, such as is now often made in a surgical operation. These perforations may heal without damage to the hearing; or perforation may follow on the ulceration caused by a foreign body; and here also, if the perforation is not large or the ulceration long-continued, the opening may heal and the patient recover his hearing. It may be asserted broadly that the opening in the membrana tympani is in itself of subordinate importance; the injury or the inflammatory lesion of the deeper structures is what determines the presence or absence of deafness. Thus a small perforation which heals rapidly may yet be the cause of great loss of hearing, because along with the perforation of the membrane, there has been injury of the deeper parts; nay, it is possible that the very closure of the membrane may have been deleterious, by obstructing the escape of discharge from the tympanum. An interesting account by Mr. Dalby of accidental lesions of the membrana tympani will be found in the 6th vol. of the 'Clin. Soc. Trans.' and in the 'Lancet' for May 29, 1876. 'Out of twenty-two cases the perforation did not heal in ten; eleven healed, and one was in process of healing when last seen; in six instances the hearing did not suffer at all; in the remaining sixteen it was more or less seriously impaired.' Mr. Dalby also points out that in cases of injury in which the membrane has not given way the hearing is generally more irreparably damaged than in those where the perforation has occurred. In one of these cases the portio dura was divided at

the same time that the membrane was perforated (by a pair of scissors), causing immediate paralysis of the features.

In other cases, after more or less protracted inflammation of the membrana tympani, it gives way, either as the result of spontaneous ulceration or from some slight injury. It seems as if the patient often produces the hole in picking his ear.

In cases of inflammation of the membrana tympani the presence of red vessels on it and the loss of its natural lustre will mark the nature of the disease. I have seen very acute suffering produced by inflammation of the proper substance of the membrana tympani, which subsided and left the hearing unaffected. When this disease is acute, free local depletion, with soothing applications and the internal use of morphia, are the main points of treatment. When the disease has gone on to perforation the first thing is to get the inflamed membrane into a perfectly quiet state. The perforation may then heal. In other cases perforation depends on some of the diseases of the tympanum to be presently spoken of, especially that which follows scarlet fever.

There is not generally any difficulty in recognising a perforation of the membrana tympani. It can be seen, or a bubble of fluid is formed in it which presents a peculiar pulsation; or the patient can blow air through it by holding his nostrils, or the surgeon can inflate it through the Eustachian tube by one of the methods shortly to be described. The perforation does not necessarily produce deafness or require treatment. In fact, the loss of hearing is connected less with the destruction of the membrane than with the diseased state of the deeper parts. In the treatment of these perforations the first care of the surgeon is (as stated above) to procure the subsidence of all inflammation in the membrane, and his next to examine the tympanic cavity carefully; for the perforation is often caused or accompanied by an obstruction of the tympanum from inspissated discharge, and this must be cured by syringing out the tympanum with astringents and alkalies from the Eustachian tube and from the perforation, before the latter can be got to heal. When all the neighbouring parts have been got into a healthy condition the nitrate of silver in stick or solution, or powdered talc, as recommended by Mr. Hinton, should be applied to the membrane, and some astringent or stimulating lotion dropped into the ear, so as to fill the tympanum; and then the patient should force the air freely through the Eustachian tube, allowing the lotion to escape gradually.[1]

Artificial membrana tympani.

When all hope of the healing of a perforation is at an end, and the patient is rendered very deaf by it, the artificial membrana tympani may be tried. This is made either on Mr. Yearsley's plan, with cotton-wool moistened with glycerine,[2] or on Mr. Toynbee's, with a disc or little ball of indiarubber mounted on a stem. If the foreign substance is pressed down, either till it impinges on the perforated membrane, or in cases where the membrane is quite destroyed on the stapes and fenestra ovalis, the hearing is sometimes very materially improved. This is a matter of direct experiment; and when the artificial membrane does good the patient soon becomes much more dexterous in its application than the surgeon can be.

The other chief phenomena which are seen in the direct examination of the

[1] Mr. Hinton prescribes the following lotions:—Hyd. Perchlor. ½ gr., or Zinci Sulph. gr. ij—x, or Liq. Ferri Perchlor. ♏ x, or Tannin gr. x—℈i, in an ounce of water, combined in each case with from 2 to 30 drops of Tinct. Opii.

[2] A small layer of cotton-wool is saturated with glycerine, and the patient is provided with a pair of forceps ending in a probe-pointed handle; with the handle he pushes the wool down the ear till he finds the place at which its lodgment assists the hearing, and the forceps enable him to withdraw it when required.

membrana tympani refer to its curvature and tension. Chronic inflammation causes rigidity and flattening of the membrane, which will no longer bulge outwards as the patient inflates the tympanum; or the membrane may have lost its tension altogether and hang down relaxed;[1] or the tympanum may be filled with secretion, driving the membrane outwards and rendering it permanently curved. In cases of relaxation advantage is sometimes derived from the use of astringent lotions and from the support of the artificial membrana tympani. Cases of increased tension and of retained secretion in the tympanum must be regarded as affections of the tympanum.

Examination of the Eustachian tube.

The Eustachian tube is accessible from the nose, though not very readily; but an easy and very useful method of inflating this tube without any direct contact was devised some years ago by Dr. Politzer, founded on the fact that the act of swallowing opens the faucial end of the tube. All that is necessary is to pass the nozzle of an empty indiarubber syringe into the nostril, hold both nostrils, so as to prevent the escape of air, let the patient hold a mouthful of water in his mouth, and as he swallows force the air out of the syringe into his nose. The air being prevented from passing down the pharynx by its contraction will be directed against the Eustachian tube, and if the tube is unobstructed the patient will feel the air pass into the tympanum. Or the surgeon can hear it do so by placing one end of an indiarubber tube about eighteen inches long (the 'otoscope') in the patient's ear and the other in his own.

The direct examination of the Eustachian tube is made with the Eustachian catheter, a small curved catheter about six inches long. This is passed gently along the floor of the nostril till it reaches the pharynx. Then, if the surgeon is familiar with the instrument, he may apply its point to the outer wall of the pharynx and slip it directly into the tube. The more common plan is to pass it on till it reaches the back of the pharynx, then pull it forward and feel along the outer wall for the end of the tube, which lies very close to the nares. This little manœuvre becomes easy with use, and is much facilitated by practising on one's self. The catheter is known to be lodged in the tube partly by its end being caught, but chiefly by finding that the air can be blown up into the ear, or solutions injected, or flexible bougies passed up.

The Eustachian tube is subject to numerous causes of obstruction producing what is called 'throat-deafness.' Such are thickening of the mucous membrane of the fauces, often an accompaniment of enlarged tonsils;[2] the inflammatory thickening of cold, relaxation of the pharyngeal mucous membrane, tumours in the pharynx, stricture of the tube itself, and foreign bodies in it. Some of these conditions can be verified by the ordinary examination of the throat, others by posterior rhinoscopy, by which method of examination the orifice of the tube can sometimes be seen; others only by the direct catheterisation of the tube. In cases of deafness which depend only on obstruction of the Eustachian tube the inflation of the tympanum will sometimes instantaneously restore the hearing, though only for a time. This circumstance justifies the assurance that the hearing will ultimately be regained.

[1] This is a consequence of disease of the tympanum, and is often caused (according to Mr. Dalby) by the injudicious habit of constantly inflating the ear. Its appropriate treatment is by the local application of sulphate of zinc, injected through the Eustachian catheter.

[2] I am not aware that there is any proof that the enlarged tonsils themselves obstruct the orifices of the tubes, but they are often accompanied by chronic thickening of the neighbouring membrane, which does do this, and which is relieved by the operation performed for the removal of the tonsils.

Affections of the tympanum.

Mr. Hinton lays down the following rules for distinguishing by means of the tuning-fork whether deafness depends on obstruction in the conducting apparatus or in the receptive part of the organ of hearing. In the former case, if disease of the meatus, membrana tympani, and Eustachian tube have been excluded by the methods of examination above detailed, the obstruction must be seated in the tympanum. If it be in the receptive apparatus—the nerves or brain—no treatment, as far as is known at present, is likely to be successful. Mr. Hinton's rules are as follows. He premises—

'That in a normal state a tuning-fork is heard before the meatus after it has ceased to be heard on the vertex. That when placed on the vertex it is heard more plainly when the external meatus is closed. Consequently, when one meatus alone is closed, the tuning-fork is heard most plainly in the closed ear.

'The reason of this fact appears to be that the sound escapes freely through the tympanum and meatus, and that when its passage is impeded the waves are reflected and affect the labyrinth more strongly. Consequently, in cases of disease the following inferences seem justified:—

'In cases of one-sided deafness, if the tuning-fork, when placed on the vertex, is heard most plainly in the deaf, or more deaf, ear, the cause of deafness is seated in the conducting apparatus; if it is heard loudest in the better ear, the cause is probably in some part of the nervous apparatus.

'If, on closing the meatus, the tuning-fork is heard decidedly louder, there is no considerable impediment to the passage of sound through the tympanum.

'If the tuning-fork is heard longer on the vertex than when placed close before the meatus, the cause of the deafness is in the conducting media.

'However imperfectly the tuning-fork may be heard when placed on the vertex, it gives reason for suspecting only, and is not proof of, a nerve-affection.'[1]

Acute inflammation of the tympanum.

Acute inflammation of the tympanum is a catarrhal affection, which produces severe pain, often extending over the whole side of the head and down the neck, aggravated by swallowing, and sometimes complicated with fever and delirium. The throat is usually also inflamed; deafness is sometimes total. The membrana tympani may be more or less congested, and the swollen mucous membrane of the tympanum can be seen through it. If air can be blown into the tympanum it causes 'a gurgling or a prolonged creaking.' The remedies should be of a soothing nature—leeches, hot fomentations, and sedative poultices, with purgatives and opiates. The terminations of the disease are threefold—either complete resolution takes place, which is very common, or matter discharges itself down the Eustachian tube, or the membrana tympani gives way. In the two former cases the hearing is usually restored, though perhaps slowly; nor is the perforation in the latter case by any means necessarily attended with any noticeable deafness. The remedies recommended are the constant inflation of the tympanum with steam containing the vapour of iodine or acetic ether; passing alkaline solutions through the nose, or, if the membrana tympani is perforated, down the meatus; and attention to the general health.

Moist and dry catarrh of the tympanum.

Inflammation of the tympanum leaves sometimes a moist, at others a semi-solid effusion in the cavity, the two being probably different stages of the same process. The kind of sound produced by inflation of the tympanum will distinguish the kind of deposit in that cavity, the bubbling of the fluid being

[1] 'Syst. of Surg.' 2nd ed. vol. iii. p. 293.

easily distinguishable from the creaking sound of dry catarrh. In the moist stage astringent injections (as sulphate of zinc) are most useful; in the dry condition the hydrochlorate of ammonia 4 grs., or bicarbonate of soda, 5 grs., or iodide of potassium, 3 grs. to the ounce, may be injected into the tympanum by means of an indiarubber bag attached to the Eustachian catheter; or the following plan may be adopted, as suggested by Grüber. The head being bent completely to the side to be acted upon, half a drachm of the solution is passed into the inferior naris from a glass syringe, and as the patient swallows it is forced into the tympanum with a Politzer's bag. The injection should be practised two or three times a week.

Accumulation of mucus in the tympanum.

Accumulation of mucus in the cavity of the tympanum, probably as the result of chronic catarrh of its lining membrane, is, in Mr. Hinton's opinion, one of the most frequent causes of deafness, which, although it becomes ultimately irremediable, may be usually cured if the disease is recognised and treated early enough. This diagnosis will rest partly on the patient's sensations, partly on the phenomena above described as indicating obstruction of the tympanum, partly on the direct examination of the cavity by the Eustachian tube and meatus. The patient is often conscious himself of something moving about in his ear, the accumulated mucus may cause a bulging of the membrane into the meatus, and the moist sounds heard on forcing air into the tympanum will confirm the diagnosis. It is chiefly in these cases that the operation of incising the membrana tympani in order to wash out the cavity is recommended. This is a simple operation in itself, and in its consequences seem to involve less danger to the apparatus of hearing than would at first sight appear probable. The patient having been placed in a good light, and, if a child or very nervous person, brought under the influence of laughing-gas or some anæsthetic, the surgeon makes a small vertical incision with a thin double-edged knife, parallel to and behind the handle of the malleus, and may, if he pleases, wash out the cavity at once by inserting a syringe into the meatus, which closes it accurately, and then forcing fluid into the meatus, which will pass through the wound into the tympanum, and so into the pharynx. Injections are then to be directed through the tympanum daily in both directions—i.e. through the opening and through the Eustachian tube—in order to detach and remove any accumulated secretion. The opening will heal in about five days, and if the relief has not been sufficient, after a due interval the proceeding may be repeated.[1]

Incision of the membrana tympani.

Disease of the tympanum in scarlet fever.

A very frequent cause of deafness, and an occasional cause of death, is the affection of the tympanum which follows on scarlatina. A similar affection occurs, though less commonly, after measles and whooping-cough. The mucous membrane of the tympanum becomes red and swollen, the cavity is filled with pus, the membrana tympani gives way, the ossicles are destroyed and come away, and often the walls of the cavity are diseased, leading to permanent otorrhœa. This is a common cause of incurable deafness. Generally this disease is not diagnosed till the otorrhœa calls the surgeon's attention to it. In early stages, however, it is possible, according to Mr. Hinton, to see the matter in the tympanum through the membrana tympani, and to give it exit by incision of the membrane and washing out the cavity.

[1] Those who have had experience of this procedure seem very doubtful as to its indications and usual results, though there can be no doubt that it is sometimes useful. See the Transactions of the Aural Section of the International Medical Congress, 1881, and Mr. Dalby's essay in the 3rd ed. of the 'System of Surgery,' vol. ii. p. 147.

For the description of the less-known affections of the tympanum, such as the formation of adhesions in it, the ankylosis of the ossicles to each other or the wall of the cavity, the growth of exostoses on the ossicles, and the degenerations of the membrana tympani, which are not known to be connected with inflammation, I must refer to some of the special treatises on these diseases.

Disease of the mastoid cells.

The mastoid cells may be affected with inflammation leading to caries and necrosis of their walls in cases where the tympanum appears to be unaffected. In such cases there will be inflammation, tenderness to pressure, redness and tumefaction behind the ear, and sometimes discharge from the meatus. Under these circumstances a free incision must be made upon the process, and if the bone is felt to be softened, or pus escapes from it, the tissue of the bone must be freely penetrated, and a free discharge obtained, which may preserve the patient from the risk of the transference of the inflammation to the lateral sinus or the encephalon.[1]

Polypi.

Aural polypi grow either from the lining membrane of the meatus, from the outer surface of the membrana tympani, or from some part of the interior of the tympanum; and their structure is said to vary according to their seat of implantation. The general character of the growth is fibrous or fibrocellular, but those that are connected with the lining of the meatus are apt to contain glandular elements analogous to the glands which are found in that membrane.[2] Their more common seat, however, is the tympanum, out of which they usually grow into the meatus, destroying the membrana tympani more or less completely. They are sometimes multiple, though less often than nasal polypi are. When the tympanum is the seat of the growth the restoration of hearing must always be very problematical; but in those that spring from the meatus a favourable issue to the case may fairly be hoped. The difficulty is to eradicate the polypus finally. Its removal is not difficult, either with small ring-forceps or by means of a snare, for which purpose Mr. Hinton prefers the gimp used by anglers. When the root of the growth can be fairly exposed its removal is easy, but it is sure to grow again unless further measures are taken. The first thing is to keep the parts behind the polypus (tympanum or meatus) free from any accumulation of discharge by copious and assiduous syringing with alkaline and astringent solutions. The next essential of treatment is to repress the growth of the tumour by the constant application of caustic to its root. 'Liq. plumbi, applied by a camel's-hair brush daily for a few days before the caustic, greatly diminishes the pain. Chloro-acetic acid, potassa fusa, carefully guarded, chromic acid, or chloride of zinc, are good caustics. Nitrate of silver is excellent in the later stages. The caustic is best applied daily until



Fig. 354. Aural polypus.

[1] See Dalby in 'System of Surgery,' 3rd ed. vol. ii. p. 152. 'Med.-Chir. Trans.' vol. lxii.

[2] Interesting details and illustrations of the structure of aural polypi are given in Mr. Dalby's 'Lectures on Diseases of the Ear,' pp. 141–147, in which he shows that many of them approach the characters of sarcoma and myxoma, and thus the obstinate tendency to recurrence may in some cases be explained, though doubtless it is oftener a consequence of imperfect removal. The structure of recent examples of polypus is much more cellular than that of those which have been longer in growing.

a decided improvement is produced, this being by far the least painless and tedious mode of using it. At the same time a lotion of perchloride of mercury (gr. $\frac{1}{3}$ ad ℥i), with tinct. opii ♏v-x, should be used twice a day; the Eustachian tube, if closed, should be made pervious; and if the membrane be perforated a syringing from the meatus through the nostril practised frequently. When the root of the polypus shows manifest signs of disappearing we can often substitute for the caustic the undiluted liquor plumbi or the powdered talc. The time occupied in the entire procedure varies from three weeks to three or four months.'

Affections of the internal ear.

The affections referred to the internal ear are little known in respect of their morbid anatomy, nor is their treatment at present at all successful. The diagnosis rests on the method of exclusion, that is to say, deafness for which no other cause can be found, in which the external and middle ear seem healthy, and the phenomena of hearing appear to indicate an affection of the receptive and not of the conducting media (see page 779), is judged to be due to some affection of the labyrinth or auditory nerve or cerebrum, though it often remains quite uncertain what that affection is. In some cases nervous deafness follows on mumps or on irritation of the trifacial nerve which may be reflected to the auditory as in other cases it is to the optic nerve (page 596 *note*). In such cases the deafness will probably be only temporary. Tumours and injuries to the base of the skull may occasion deafness from direct lesion of the nerve or its roots in the brain. Hereditary syphilis sometimes occasions deafness, though I know not what is the anatomical cause.[1] In some cases this deafness may subside under the general and local treatment suggested by the diathesis. Nervous deafness also occurs from functional disturbances, mental and physical, of various kinds. It may be caused by an overdose of quinine, and cured, according to Mr. Toynbee, by the same drug in small doses. It is often accompanied by distressing tinnitus, and for such cases as well as those which are truly neuralgic Mr. Hinton recommends the hydrochlorate of ammonia in full doses. Finally, in old age deafness is often the sign of a loss of the sense, i.e. of permanent and irremediable degeneration of the nerve or the structures in which it terminates. I do not speak here of the congenital deafness which depends on malformation of the internal parts of the ear (deafmutism), since this affection, interesting as it has become of late, from the successful education of its victims, hardly falls within the domain of practical surgery.

Diseases implicating the brain.

One of the most formidable characters of disease of the ear is its liability to extend to the brain. Inflammation of the meatus or mastoid cells tends to spread towards the lateral sinus or the cerebellum, inflammation of the tympanum towards the middle lobe of the brain, and that of the labyrinth along the auditory nerve towards the medulla. The result is meningitis, abscess in the substance of the brain, or phlebitis of the lateral sinus, possibly followed by pyæmia. The symptoms commence with pain in the head and neck, and rigors; then delirium ensues, followed by paralysis, coma, and death. In cases of general pyæmic affection from phlebitis of the lateral

[1] The deafness of hereditary syphilis is one of the later or tertiary phenomena of that disease. It comes on usually between the ages of five and fifteen, and often proceeds gradually to total deafness. Mr. Dalby tells me that three weeks is the shortest and five years the longest period that he has known this disease to be in progress before the hearing was entirely lost.

sinus, the characteristic symptoms of pyæmia will be superadded. The affection follows on all kinds of diseases of the ear, but mainly, I believe, on the acute inflammation of the tympanum, which is one of the sequelæ of scarlet fever, and which rapidly spreads to the bone; in fact, the more the bone is inflamed and the acuter that inflammation is, the more danger there is of cerebral complications. This is strictly analogous to what we have noted above with regard to acute inflammation of bone in other parts. But these complications also follow in chronic diseases of the ear, though in such cases the discharge has generally ceased on a sudden, and in all probability such obstruction marks the supervention of some acute disease of the bone, which rapidly spreads along the veins to the interior of the skull.

Treatment can be of any avail only in the first stage of the disease, when pain in the head and the cessation of some habitual discharge gives warning to the surgeon of the possibility of the inflammation spreading inwards. Free leeching behind the ear, incision down to the mastoid process, if there is any puffiness or tenderness there; blistering behind the ears or setons in the nape of the neck, purgatives, and the encouragement of the discharge by assiduous warm syringing and fomentation, are the measures which seem most worthy of trial. Possibly, if the membrana tympani be entire it may be well to incise it, and wash out the tympanic cavity.

Menière's disease.

In connection with nervous deafness and affections of the internal ear I ought to mention the obscure and singular affection, called after its describer 'Menière's disease,' in which a person previously in good health suffers from a severe attack of vertigo, sometimes so that he falls down and cannot stand for a long time, and this is accompanied by some tinnitus. On recovering from this condition one ear is found to be quite deaf. No disease can be detected in the tympanum, nor is the general health afterwards affected. 'The nervous lesion,' as Mr. Dalby says, 'must be situated in the brain or the labyrinth—most likely the latter.' An interesting paper on this subject will be found in vol. viii. of the 'St. George's Hospital Reports' by Dr. C. Allbutt. He gives the notes of a large number of cases in his own practice, and asserts that the disease is neither rare nor hard to diagnose, believing that the only reason for its appearing rare is that many practitioners are not familiar with it, and so ascribe its symptoms to other causes. Dr. Allbutt follows Dr. Ferrier[1] in believing that the essential lesion in Menière's disease is seated in the semicircular canals.[2] Its leading symptoms, according to him, are a loss in the affected ear of the power to hear sounds transmitted through the cranial bones (not necessarily, though commonly, also deafness to aerial vibrations), giddiness, vomiting, a reeling gait and roaring in the ears. 'It differs from cerebral disease in the greater continuance and recurrence of intense vertigo, vertigo often worse than that caused by any other malady, by the absence of loss of consciousness and by the concurrence of the vertigo with remarkable noises in the ears.' Counter-irritation, rest, and soothing remedies (chiefly the bromide of potassium) are the means generally used in treating this remarkable affection, but hitherto no effectual treatment has been introduced.

[1] 'West Riding Asylum Reports,' vol. v.

[2] This, however, is doubted by Mr. Dalby, who is more disposed to refer the disease to reflex irritation of the pneumogastric nerve set up by some lesion in the course or near the root of the auditory nerve.

CHAPTER XXXVII.

DISEASES OF THE URINARY ORGANS.

SURGICAL AFFECTIONS OF THE KIDNEY.

Nephritis.

ACUTE inflammation of the kidney is a very common complication in surgical cases, and occurs usually as an extension of the inflammation of the bladder, which will presently be described as the result of stricture, stone, diseased prostate, and other common surgical affections. It may also follow on injuries, or arise from exposure to cold, or from poisoning by cantharides, or alcohol. It is marked by rigors, vomiting, pain in the back, frequent scanty micturition, bloody or albuminous urine, frequently purulent, and often containing casts of the renal tubes, with a good deal of general fever. In idiopathic cases anasarca may occur and total suppression of urine. Suppuration in the substance of the kidney may ensue, marked by increase of pain and retraction of the testicle, and is rapidly followed by the unconsciousness and sinking which attend uræmic poisoning.

Affections simulating nephritis. Calculous nephralgia.

The passage of a calculus down the ureter—'calculous nephralgia'—is attended with some of the above symptoms. 'Indeed, excepting the severe febrile symptoms, all those of nephritis are present,' the leading symptoms being acute pain shooting down the loins, retraction of the testicle, and vomiting. The urine is scanty and often mixed with blood. The suddenness of the invasion of the disease, the comparatively healthy condition of the urine, and especially the instantaneous subsidence of the symptoms as the stone passes into the bladder, are diagnostic signs from nephritis. The treatment consists in the very free use of the hot bath, cupping and fomentations to the loins, the free administration of opium and other narcotics, and, if the pains are severe, the occasional administration of chloroform—not to total anæsthesia.

Calculous pyelitis.

Acute calculous pyelitis is distinguished, according to Sir H. Thompson, from nephritis by the greater severity of the pain in the back, and the retraction of the testicle, and by the less rapid course of the disease. Blood and pus will be found in intimate admixture with the urine.

Abscess, rheumatism, and cystitis.

Nephritis may also be confounded with abscess from diseased spine, with lumbago or rheumatic affection of the muscles, and with hysterical or neuralgic pain; but the special symptoms of all these conditions are almost in themselves sufficient to mark the difference, and the state of the urine is a conclusive proof of the absence of nephritis.

Finally, inflammation of the bladder from stone or other causes may to a great extent simulate renal inflammation, and, of course, the two are very often combined in various proportions. But the localised pain in the region of the bladder, the absence of any tenderness in the lumbar region, and the discovery of the cause of the cystitis, will distinguish it from nephritis.

Treatment of nephritis.

The treatment of acute nephritis is directed chiefly to relieving the congested kidney by free diaphoresis from the skin, by free purging, and by leeches and counter-irritation to the loins,[1] with perfect rest and low diet. The

[1] The common blister should not be used in these cases, for fear of the absorption of the cantharides. A blister can be raised at once by the strong liquor ammoniæ or by chloroform covered with a watch-glass or oiled silk.

vomiting must be combated by hydrocyanic acid or kreosote, and by mustard-poultice to the pit of the stomach. At the same time any known cause of inflammation or obstruction must if possible be removed, and as little mechanical interference with the urinary organs practised as the exigencies of the case permit.

Nephrolithotomy.

The diagnosis and treatment of calculus in the kidney come rather within the province of works on medicine. The surgeon is sometimes consulted as to the possibility of removing a stone from the kidney, and the operation has now been frequently performed with success, the stone having either been found in the pelvis of the kidney, or lying under a thin layer of kidney-substance which has been incised. No formal directions are required for these operations, which are really less formidable than would at first sight be imagined, to judge from the opportunities which I have hitherto had of witnessing them. In a gratifying case recently in St. George's Hospital a large stone which had long been a source of pain and hæmaturia was removed from the substance and pelvis of the kidney by Mr. Haward with perfect success. It is often possible in these cases to complete the diagnosis by feeling the stone with a needle either passed down through the skin, or from the wound before the kidney is incised. Often, however, the stone is rather situated in a cavity near the kidney than in the organ itself, and under these circumstances is much more favourably situated for extraction.

Nephrectomy.

Still more daring is the attempt to remove the entire kidney, which however has now been made in more than fifty cases, and with a very fair proportion of success. The operation has been performed either for movable kidney accompanied with much pain, for old scrofulous disease exhausting the patient by constant discharge, for cystic degeneration, or for tumour. In the last class of cases, as the disease has usually been of a cancerous nature, the operation has been less clearly justifiable, and also far more fatal. In the three former classes, the removal of the kidney is certainly indicated. The kidney may either be removed by a free incision from the loin, or by abdominal section through the peritoneal cavity. The former is to be preferred whenever the mass is not so large as to render it impossible to obtain thus a free access to the pedicle. It is of course necessary to have the pedicle perfectly exposed, in order to command the great vessels completely before removing the organ. I would refer the reader on this subject to a paper by Mr. Barker in the 63rd and 64th volumes of the 'Med.-Chir. Trans.'

Chronic nephritis.

Chronic nephritis, as a sequel of the acute, and the other conditions which lead to albuminuria, or Bright's disease, would form a subject too extensive and too purely medical for the present place. I will content myself with saying that in all surgical cases the state of the urine should be carefully examined, and the surgeon should be familiar with the signs of chronic degeneration of the kidney, since they powerfully influence prognosis, and will often contra-indicate operations and other active treatment in diseases where such treatment would otherwise be pressed upon the patient.

Hæmaturia.

The passage of blood in the urine is a frequent symptom both in medical and surgical practice; and although the treatment of many of the conditions which give rise to it lies within the province of the physician, yet it is necessary to review all of them for the purpose of diagnosis.

The blood may come (1) from the kidney, including the ureter; (2) from the bladder, including the prostate gland; (3) from the urethra.

1. The sources of renal hæmorrhage are—rupture or laceration of the

CHAPTER XXXVII.

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SURGICAL AFFECTIONS OF THE KIDNEY.

Nephritis.

ACUTE inflammation of the kidney is a very common complication in surgical cases, and occurs usually as an extension of the inflammation of the bladder, which will presently be described as the result of stricture, stone, diseased prostate, and other common surgical affections. It may also follow on injuries, or arise from exposure to cold, or from poisoning by cantharides, or alcohol. It is marked by rigors, vomiting, pain in the back, frequent scanty micturition, bloody or albuminous urine, frequently purulent, and often containing casts of the renal tubes, with a good deal of general fever. In idiopathic cases anasarca may occur and total suppression of urine. Suppuration in the substance of the kidney may ensue, marked by increase of pain and retraction of the testicle, and is rapidly followed by the unconsciousness and sinking which attend uræmic poisoning.

Affections simulating nephritis. Calculous nephralgia.

The passage of a calculus down the ureter—'calculous nephralgia'—is attended with some of the above symptoms. 'Indeed, excepting the severe febrile symptoms, all those of nephritis are present,' the leading symptoms being acute pain shooting down the loins, retraction of the testicle, and vomiting. The urine is scanty and often mixed with blood. The suddenness of the invasion of the disease, the comparatively healthy condition of the urine, and especially the instantaneous subsidence of the symptoms as the stone passes into the bladder, are diagnostic signs from nephritis. The treatment consists in the very free use of the hot bath, cupping and fomentations to the loins, the free administration of opium and other narcotics, and, if the pains are severe, the occasional administration of chloroform—not to total anæsthesia.

Calculous pyelitis.

Acute calculous pyelitis is distinguished, according to Sir H. Thompson, from nephritis by the greater severity of the pain in the back, and the retraction of the testicle, and by the less rapid course of the disease. Blood and pus will be found in intimate admixture with the urine.

Abscess, rheumatism, and cystitis.

Nephritis may also be confounded with abscess from diseased spine, with lumbago or rheumatic affection of the muscles, and with hysterical or neuralgic pain; but the special symptoms of all these conditions are almost in themselves sufficient to mark the difference, and the state of the urine is a conclusive proof of the absence of nephritis.

Finally, inflammation of the bladder from stone or other causes may to a great extent simulate renal inflammation, and, of course, the two are very often combined in various proportions. But the localised pain in the region of the bladder, the absence of any tenderness in the lumbar region, and the discovery of the cause of the cystitis, will distinguish it from nephritis.

Treatment of nephritis.

The treatment of acute nephritis is directed chiefly to relieving the congested kidney by free diaphoresis from the skin, by free purging, and by leeches and counter-irritation to the loins,[1] with perfect rest and low diet. The

[1] The common blister should not be used in these cases, for fear of the absorption of the cantharides. A blister can be raised at once by the strong liquor ammoniæ or by chloroform covered with a watch-glass or oiled silk.

vomiting must be combated by hydrocyanic acid or kreosote, and by mustard-poultice to the pit of the stomach. At the same time any known cause of inflammation or obstruction must if possible be removed, and as little mechanical interference with the urinary organs practised as the exigencies of the case permit.

Nephrolithotomy.

The diagnosis and treatment of calculus in the kidney come rather within the province of works on medicine. The surgeon is sometimes consulted as to the possibility of removing a stone from the kidney, and the operation has now been frequently performed with success, the stone having either been found in the pelvis of the kidney, or lying under a thin layer of kidney-substance which has been incised. No formal directions are required for these operations, which are really less formidable than would at first sight be imagined, to judge from the opportunities which I have hitherto had of witnessing them. In a gratifying case recently in St. George's Hospital a large stone which had long been a source of pain and hæmaturia was removed from the substance and pelvis of the kidney by Mr. Haward with perfect success. It is often possible in these cases to complete the diagnosis by feeling the stone with a needle either passed down through the skin, or from the wound before the kidney is incised. Often, however, the stone is rather situated in a cavity near the kidney than in the organ itself, and under these circumstances is much more favourably situated for extraction.

Nephrectomy.

Still more daring is the attempt to remove the entire kidney, which however has now been made in more than fifty cases, and with a very fair proportion of success. The operation has been performed either for movable kidney accompanied with much pain, for old scrofulous disease exhausting the patient by constant discharge, for cystic degeneration, or for tumour. In the last class of cases, as the disease has usually been of a cancerous nature, the operation has been less clearly justifiable, and also far more fatal. In the three former classes, the removal of the kidney is certainly indicated. The kidney may either be removed by a free incision from the loin, or by abdominal section through the peritoneal cavity. The former is to be preferred whenever the mass is not so large as to render it impossible to obtain thus a free access to the pedicle. It is of course necessary to have the pedicle perfectly exposed, in order to command the great vessels completely before removing the organ. I would refer the reader on this subject to a paper by Mr. Barker in the 63rd and 64th volumes of the 'Med.-Chir. Trans.'

Chronic nephritis.

Chronic nephritis, as a sequel of the acute, and the other conditions which lead to albuminuria, or Bright's disease, would form a subject too extensive and too purely medical for the present place. I will content myself with saying that in all surgical cases the state of the urine should be carefully examined, and the surgeon should be familiar with the signs of chronic degeneration of the kidney, since they powerfully influence prognosis, and will often contra-indicate operations and other active treatment in diseases where such treatment would otherwise be pressed upon the patient.

Hæmaturia.

The passage of blood in the urine is a frequent symptom both in medical and surgical practice; and although the treatment of many of the conditions which give rise to it lies within the province of the physician, yet it is necessary to review all of them for the purpose of diagnosis.

The blood may come (1) from the kidney, including the ureter; (2) from the bladder, including the prostate gland; (3) from the urethra.

1. The sources of renal hæmorrhage are—rupture or laceration of the

kidney by a blow or fall, cancer of the kidney, and possibly other tumours; congestion from nephritis or from the use of certain drugs; the irritation of a calculus, either in the kidney or ureter; to which may be added that in some general diseases, such as purpura, the hæmorrhagic diathesis, scurvy and the 'endemic hæmaturia,' lately described as prevailing in Africa, blood passes from the kidneys.

The diagnostic symptoms of such of these affections as lie within the province of surgery will be found under their appropriate headings, to which I will only add that the blood from the kidneys is always intimately mixed with the urine (giving it a dark porter-colour), and that 'as a general rule such urine, passed without pain or any other local symptom whatever, is more likely to derive its blood from the kidney than elsewhere' (Sir H. Thompson). The urine should be carefully examined microscopically, in order to determine the presence or absence of casts of the kidney-tubes.

2. The sources of vesical hæmaturia are—wound of the bladder or prostate; tumour, cancerous or villous; calculus in the bladder; congestion of the prostate gland; ulceration of the coats of the bladder or acute congestion in cystitis.

Blood from the bladder is generally less intimately mixed with the urine than that from the kidney; it very commonly clots in the bladder and remains behind after the urine has been passed; the urine first passed is often comparatively clear, while at the end of micturition the blood is passed almost or quite pure. But these signs are not always to be implicitly relied on, and the surgeon must examine the patient carefully for the diagnostic symptoms of the affections above enumerated.

3. Urethral hæmorrhage is caused by blows or wounds (including laceration by the catheter), impacted calculus, rupture of the corpus spongiosum in sexual intercourse or chordee; tumours in the urethra; ulceration, chiefly in syphilis; congestion in gonorrhœa or stricture.

The most reliable test of this source of hæmorrhage is when it can be detected as occurring independent of micturition, which can almost always be done if the patient be carefully watched, or when the blood collects in the urethra and forms a cast of it.

The source of the hæmorrhage being determined and its supposed cause, the treatment of the latter is of course the main indication, but the hæmorrhage itself sometimes requires treatment. The bladder may be so abundantly occupied by clot as to require its disintegration and removal piecemeal, by means of the injecting catheter; the amount of blood from the kidney may be so alarming as to demand the administration of internal styptics; urethral hæmorrhage may sometimes be controlled by pressure, a metal catheter having first been passed; and perfect rest should in all cases be enforced, whenever the bleeding is considerable.

Suppression of urine.

Suppression of urine is an event which is almost certainly fatal, and which must be carefully distinguished from retention. Obvious as this distinction is, it is strange how often the mistake is still made. The causes of suppression are general, while those of retention are local; in suppression the bladder is found perfectly empty on passing a catheter, or almost so; the patient experiences no difficulty in passing water, but has none to pass, or only a very small quantity. He is troubled with vomiting and generally pain in the back, and is feverish; becomes stupid, perhaps delirious, and then comatose, and almost always dies. Sir H. Thompson mentions a case in which the patient recovered

after forty-eight hours of complete suppression, and I have known another similar one. The chief points in the treatment are free action on the skin by the hot bath and vapour bath, fomentations and leeches to the back, and free purgation.

DISEASES OF THE BLADDER.

Malformations.

THE bladder has been absent, the ureters opening into the urethra, rectum or vagina, but the malformation is a very rare one.

Congenital cyst.

Less uncommon is the presence of a 'double bladder,' or large congenital cyst, of which a remarkable instance, shown in fig. 355, occurred in my own practice. Such cases cannot be diagnosed or treated during life. Their main interest consists in knowing that such a diverticulum may occur, and may very easily become the seat of a calculus, which then would present great difficulties in its operative treatment.

Extroversion.

The ordinary malformation of the bladder, however, is *extroversion*. This condition depends on a malformation of the abdominal parietes. In most cases the whole of the hypogastric region is deficient, from the navel to the pubes. There is no umbilicus; the anterior wall of the bladder is also deficient: its posterior wall is attached to the skin and projects from the belly in the form of a red prominence, bleeding readily, and showing the slit-like mouths of the ureters, from which the urine can be seen distilling. The parietes extend, however, in some cases lower than the umbilicus, which is then natural. Bounding the extroverted bladder is a double ridge, like a V inverted, which marks the coalescence of the skin and bladder. The penis is rudimentary, and is marked by a groove on its dorsal aspect, into the back of which as it joins the vesical membrane the semen is discharged in adult life. The prostate is hardly to be discerned. The testicles are generally natural. There is often hernia on one or both sides. The pubic symphysis is often deficient.

The same malformation occurs in the female sex also, but much more rarely.[1] It is not necessarily complicated with any malformation of the internal sexual organs, and women so afflicted have borne children.

The malformation is perfectly consistent with health, and I have often seen vigorous adults affected by it. Its inconveniences are the constant dribbling of urine and the tendency of the exposed membrane to bleed. The latter infirmity may be corrected by a plastic operation which was first successfully performed in this country by me in the year 1863,[2] and a similar proceeding has been successfully repeated by Mr. J. Wood and other surgeons. It consists in bringing two skin flaps over the bladder, one turned with its cutaneous surface downwards, so as to be in contact with the extroverted mucous membrane; the other with its raw surface downwards and in contact with the raw surface of the former. These being united to each other form a thick bridge over the cleft, which may be afterwards implanted into the skin of the abdomen till only a narrow orifice is left below, to which a bottle can easily be applied. But the patient or his friends must be instructed to wash out the cavity frequently with acidulated water, to prevent the formation of phosphatic concretions. Attempts have been made to divert the course of the ureters into the rectum, so as to form a cloaca there, and obviate any incontinence of urine, but these have hitherto failed.

[1] See a paper by Dr. Champneys on 'Extroversion of the Bladder in the Female,' in 'St. Barth. Hosp. Reports,' vol. xiii. See also an extraordinary case, described in the 'Gaz. des Hôp.' July 21, 1877, in which the vagina was entirely absent, and the uterus opened externally.

[2] 'Lancet,' 1863, vol. i. p. 714.

Inversion of the bladder.

In connection with malformations I may mention the inversion of the female bladder which is sometimes met with in childhood, and which though not due to malformation might easily be mistaken for it. It seems to occur from constant straining in making water. The bladder projects through the urethra, as a pyriform red vascular tumour in which the orifices of the ureters can be seen. On a careless examination this might be mistaken for extroversion, or still more fatally for a polypus, and it has nearly been tied on that suspicion. Treatment by careful reduction, maintained by a catheter with a bulbous end, and frequent cauterisation of the expanded urethra with the actual cautery, has been successful in restoring the power of retaining the urine.[1]

Hernia of the bladder.

The bladder may protrude as a hernia into the scrotum or vagina, or may form part of the contents of an inguinal hernia in the male, or a femoral in the female. The occurrence is a rare one, the diagnosis difficult, and in one case recorded by Pott the herniated bladder was opened by mistake. When, by careful examination, the surgeon has reason to apprehend that the bladder is herniated—i.e. when pressure on the hernia always causes the immediate exit of urine, and when a catheter passes into or towards the hernial orifice—double care should be exercised to reduce it and keep it reduced. In the female, when it protrudes into the vagina it forms one of the forms of vaginal cystocele, which will be found treated of in a subsequent chapter.



FIG. 355. Malformation of the bladder, showing a large cyst, or false bladder, which communicates with the true bladder. The parts were taken from a male infant, who was born with retained testicles and a peculiar shape of the abdomen the parietes of which were deficient below, so that the viscera protruded beneath the skin. There was a nævus on the skin of the pubes. The child throve for a few days, then began to refuse the breast, passed blood in the water, and died on the sixth day. *a*, the bladder with the large cyst lying above it. This was the true bladder; its walls were much hypertrophied, and its interior covered with nævus tissue, from which doubtless the bleeding had come. The openings of the ureters and urethra were quite natural; *b*, a rod passed into the secondary cyst, the walls of which were very thin and destitute of muscle. It showed no trace of any vascular tissue on its interior. It lay on the right side of the pelvis and right iliac fossa. Death had evidently been caused by its pressure on the ureters. The kidneys, *c*, *d*, are seen to be much dilated and absorbed by pressure, especially on the left, and the ureters were dilated and tortuous. The testicles lay close below the kidneys. 'Path. Soc. Trans.' vol. xvi. p. 169; St. George's Hospital Museum, Ser. xii. No. 118.

Tumours of the bladder.

Many kinds of tumour have been found springing from the walls of the bladder. The innocent tumours are warty growths, polypi, and fibrous tumours. These, however, are rarely found, and can hardly be diagnosed, at least in the male. They cause merely symptoms of obstruction to the flow of urine, the cause of which it is impossible exactly to discover. In the female, where the finger can be passed into the bladder under chloroform, the diagnosis might be made and the tumour removed by ligature. These tumours are too rare to require more than a passing mention. But the tumours which are

[1] Lowe, in 'Lancet,' 1862, vol. i. p. 250.

commonly met with in practice, and which give rise to definite symptoms of their own, besides those which are due to the mere obstruction caused by their position, are the villous tumour and cancer.

Villous tumour of the bladder is usually innocent, both structurally and surgically (see p. 361), though a cancerous tumour may also sometimes be covered by villous processes of mucous membrane, as seen in Fig. 356. The true villous tumours, however, consist merely of numerous processes exactly resembling the villi of the chorion in structure, very vascular, and often developed at different parts of the bladder, so as to form multiple growths, many of which are only perceptible on anatomical examination, and probably give rise to no symptoms. When the growth has attained a size large enough to

Villous tumour.



Fig. 356. A mass of malignant disease, growing out of a cyst on one side of the bladder, and projecting to a certain extent into its cavity. Its outward appearance is exactly that of villous tumour, and it is only on microscopic examination that the difference is perceived. The disease had existed for many years, and at times occasioned hæmorrhage, the source of which could not be detected.—From the Museum of St. George's Hospital, Ser. xii. No. 24.

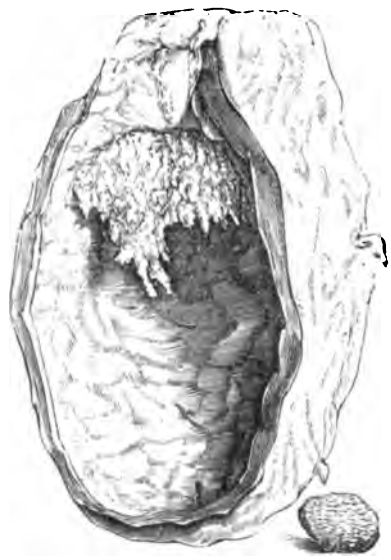


Fig. 357. Villous tumour of the bladder, from a patient æt. eighty-one, who had suffered from attacks of hæmaturia occasionally for twenty years. The mass of the growth is seen to be connected with the neck of the bladder. A portion, consolidated by coagulum, so as to resemble a soft calculus, was found loose in the bladder, and is represented in the corner of the figure. The patient had exhibited no dangerous symptoms till shortly before his death, as the hæmaturia had yielded to astringents. But a week before his death complete retention of urine came on, requiring the use of the catheter, and a small portion of the growth came away in the eye of the instrument, which on microscopical examination revealed the nature of the disease.—From a preparation in the Museum of St. George's Hospital, Ser. xii. No. 113.

form a tumour (as in Fig. 357) it usually gives rise to fits of hæmaturia, which, however, as in that case, may be extremely irregular, separated by long intermissions of perfect health. The pain caused by this tumour depends apparently on its situation in the bladder. When a small tumour (whether villous or malignant) is growing near the neck of the bladder and is tightly grasped by its muscular fibres during each action of the bladder the pain is often very considerable—indeed, I have known it to be agonising—whilst a similar tumour might exist in the fundus or upper part of the bladder with comparatively few symptoms. The same applies to retention of urine as well as to pain.

Cancer of the bladder is generally of the encephaloid variety. I have not

Cancer.

Diagnosis of cancer.

as yet met with any other form of cancer as a primary growth, though authors admit the existence of scirrhus, and Sir H. Thompson has recorded one of epithelioma.[1] Other forms of cancer affect the bladder by continuity, as in scirrhus of the rectum, epithelial cancer of the vagina, &c. The symptoms of cancer of the bladder are usually persistent hæmaturia, 'generally,' says Sir H. Thompson, 'occurring suddenly, and in large quantities, rather than by frequent or continuous oozings from capillary vessels, which latter mode is more characteristic of villous growths.' There is usually much distress from obstruction to micturition and from chronic cystitis, great pain in the bladder or perinæum, and shooting down the thighs or into the loins. The general health usually soon suffers, and the glands in the iliac fossa or in the loins become enlarged. Death generally occurs early.

As to the diagnosis of tumour of the bladder. This rests (*a*) on exclusion of the other sources of hæmaturia, (*b*) on direct examination, (*c*) on detection of portions of the growth in the urine.

Reference may be made to the section on Hæmaturia (p. 785) for the symptoms attending the various forms of bleeding from the urethra. The patient must be carefully sounded, when not only will there be no sensation or sound of stone, but the tumour may sometimes be easily felt. Prostatic hæmorrhage sometimes gives rise to a suspicion of tumour, but the transient character of this affection will distinguish it, at any rate, from the hæmaturia due to malignant disease.

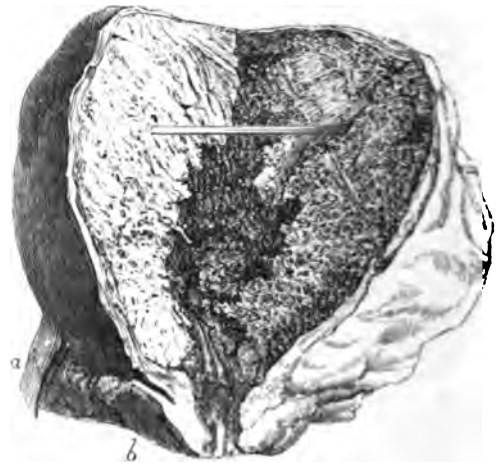


FIG. 358. Malignant disease, nearly filling the cavity of the bladder; *a* points to the ureter, which is somewhat dilated: *b* shows the urethra and prostate quite unaffected; the disease being limited to the cavity of the bladder.—St. George's Hospital Museum, Ser. xii. No. 26.

The tumour, when malignant, sometimes grows so rapidly as to fill the bladder almost entirely, or projects as a large hard mass, easily felt with the sound. But this is by no means common, and the absence of any sensation of tumour does not go for much in the diagnosis. At other times the surface of the tumour breaks down rapidly, and shreds of it come away in the urine, the structure of which can easily be recognised by microscopic examination, and it is said that separate cancer-cells may be recognised in the urine; but mistakes are so often made about this, from taking the cells of epithelium variously modified for cancer-cells, and in cases of cancer it is so common for no such cells to be found, that I think little importance is to be attributed to microscopic examination.

In cases of rapidly growing cancer, apart from all direct examination, when once the diagnosis of stone and of prostatic hæmorrhage is excluded, the course of the symptoms usually sufficiently indicates the nature of the case.

[1] 'Path. Soc. Trans.' vol. xviii. p. 162. There was a similar growth in the kidney. In the opinion of many microscopists, however, most of the tumours which are classed here as encephaloid are more correctly regarded as epithelioma. The point is one of little importance. At any rate, the malignant tumour usually grows with great rapidity, ulcerates soon, and bleeds copiously.

To diagnose a villous growth is often a very difficult matter; in fact, the diagnosis is often made only conjecturally, by excluding other sources of hæmaturia. In a case, such as that from which Fig. 357 was taken, where the symptoms extend over many years, and cannot be referred to prostatic causes, the diagnosis is extremely probable, and sometimes, as in that instance, is rendered certain by the accidental escape or detachment of a portion of the tumour. Diagnosis of villous tumour.

The treatment of either of these forms of tumour can in general be only palliative, i.e. directed to subdue pain by opiates and to check hæmorrhage from the bladder by astringents. In cancer the disease will probably prove fatal within a few months. Cases of villous tumour run too irregular a course to justify any confident prognosis. Sometimes, as in the case referred to above, the patient lives many years in moderate comfort. At others the growth rapidly implicates the neck of the bladder. and the exhaustion caused by hæmaturia and cystitis soon exhausts the patient's powers. In general it is most prudent to abstain from any mechanical interference in cases diagnosed as villous tumour, the passage of instruments being only resorted to when absolutely necessary, since every contact of the catheter must increase the bleeding. In the female such tumours have been felt with the finger and removed with the wire-écraseur. Mr. Harrison [1] of Liverpool relates a case in which this operation was twice performed on a woman æt. 35, with a good result. In the male sex, the diagnosis of villous and other tumours by direct digital examination has recently been recommended and extensively practised by Sir H. Thompson, and a very gratifying amount of success has been obtained. He makes a free incision into the urethra in the middle line of the perinæum, along which the finger is passed through the prostate and neck of the bladder into its cavity. Being empty, the whole interior of the bladder can be examined by the finger, aided by counter-pressure above the pubes, and the tumour can then be brought into the grasp of a pair of forceps and removed. It is of course true that the same tumour may grow again, or that another, which was imperceptible at the time of operation, may take on active growth; so that complete success can never be promised; and if the growth be malignant the operation may easily prove fatal. Still, the attempt marks a distinct advance in the surgery of the urinary organs.[2] Removal of villous growths.

Inflammation of the bladder is divided into three degrees, acute, sub-acute, and chronic. Most of the cases which are seen in surgical practice belong to the subacute or the chronic variety. The causes are usually those which produce obstruction to the flow of water or direct irritation of the mucous membrane. Thus cystitis is a frequent, or even constant, complication of stricture and enlarged prostate; it is one of the symptoms of stone or other foreign body in the bladder, and is very liable to be caused by the retention of a catheter in the bladder. Fractured spine usually produces cystitis, and cystitis is often produced by the irritation from decomposing urine in other forms of paralysis where the patient is unable to pass water. Some materials which are eliminated by the urine out of the blood having been taken as food or absorbed from the skin may cause cystitis. The familar example of this is the inflammation of the bladder sometimes produced by cantharides taken Cystitis.

[1] 'Lectures on Diseases of the Urinary Organs,' 1878, p. 180.

[2] The operations of Sir H. Thompson and previous operators will be found recorded by him in the 66th vol. of the 'Med.-Chir. Trans.' See also Ransokoff, 'Medical News,' Feb. 10, 1883, and Thompson in 'Syst. of Surg.' 3rd ed. vol. iii. pp. 188–194.

into the stomach or applied as a blister. The bladder may also be inflamed by the spread of inflammation from a neighbouring organ, as in gonorrhœa or in inflammation of the prostate. Finally, direct mechanical violence, as in surgical operations, is a frequent cause of cystitis, and it may originate spontaneously, either from exposure to cold, or from tubercular irritation, or the softening of tubercular deposit, or from no known cause whatever.

Anatomy of cystitis.

Inflammation of the bladder commences always on its mucous surface, the membrane becoming so loaded with blood as to assume a dark purple colour, thickened and velvety, in some cases coated with adherent lymph and phosphatic deposit from the urine, in others ulcerated here and there. The irritation which accompanies it produces frequent and spasmodic muscular action. Often the cause of the affection involves obstruction, and consequently much straining to make water, and from these circumstances muscular hypertrophy is a constant phenomenon in cystitis, so that the muscular fibres stand out under the mucous surface somewhat like the columnæ carneæ of the heart, and they cross each other in every direction, leaving small spaces or alveoli between them. To this condition the terms 'columnar and fasciculated bladder' are applied. The mucous coat of the bladder is often protruded through the opening of these fasciculi, causing pouches which sometimes do not reach through the whole thickness of the walls of the bladder (Fig. 384), while at other times they form distinct and definite projections (Fig. 385), often of very large size. Similar and sometimes much larger pouches or cysts are found as congenital malformations (Fig. 355).

The symptoms of cystitis in the acute form are general fever, great pain in making water, frequency in micturition, bloody urine, soon turning purulent, pain and tenderness to pressure in the region of the bladder, and pain extending down the thigh and perinæum; often also the straining produces prolapsus or piles.

Formation of ropy mucus.

We commonly see, however, the less severe form, which is variously described as subacute or chronic, in which the mucous membrane of the bladder secretes an abundant deposit of alkaline mucus or muco-pus, and in which the urine is turbid and contains a variable quantity of a mortary deposit usually called 'ropy mucus.' This deposit is formed of phosphate of lime mixed with pus and mucus, and is very viscid, clinging to the vessel when inverted and slowly falling out in a mass. The supernatant urine, when examined by the microscope, usually is found to contain a good deal of pus, and the triple phosphate of ammonia and magnesia. This phosphate is also sometimes found mixed with the phosphate of lime in the sediment. The urine decomposes, becoming intensely alkaline and ammoniacal, whereas, when the mucus is only in small quantity, though the deposit is itself alkaline, the urine may be acid.[1] It appears, then, that the essential cause of the decomposition of the urine is the mixture with it of the alkaline mucus or muco-pus secreted by the walls of the bladder; and this decomposition is connected, at any rate by some pathologists, with the chemical composition of urea. Thus, the formula for urea being $C_2 H_4 N_2 O_2$, its elements are exactly the same as those of carbonate of ammonia, minus 2 atoms of water. Thus, 2 atoms of carbonic acid $C_2 O_4$ + 2 atoms of ammonia $N_2 H_6$ = $C_2 O_4 N_2 H_6$ − deduct $O_2 H_2$ (2 atoms of water), and the result is as above, $C_2 H_4 N_2 O_2$, or one atom of urea. This decomposition readily ensues out of the body on heating urea with an alkali, and the decomposition of the urine is regarded (and certainly with the highest probability) as an analogous

[1] Sir B. Brodie's Works, vol. ii. p. 466.

if not identical chemical change. The carbonic acid partly goes to the base of the phosphate of lime, forming carbonate of lime, which is found to constitute a part of the mortary mass, and the ammonia is partly set free, partly unites in forming the ammonio-magnesian phosphate. This ammoniacal urine again acts as an irritant on the bladder and propagates the inflammatory condition by which it was caused; the inflammation may even spread up the ureters to the pelvis of the kidney, exciting inflammation of its lining membrane, in which case the urine will be secreted alkaline, and earthy phosphates may be found on the renal calyces; sometimes the inflammation causes the formation of small abscesses beneath the lining membrane of the kidney, a condition to which the term pyelitis is applied.

Other changes occur also in the bladder besides the ordinary morbid phenomena above described. Generally speaking the inflammation produces only muscular hypertrophy accompanied by no permanent change of the mucous membrane; but in some cases organised inflammatory or fibroid deposit may be found in the submucous coat. At other times deposits of pus (abscess of the bladder) occur in the thickness of its walls; and there are cases (though chiefly in stone or foreign body) where the mucous coat is ulcerated, or even where ulceration extends through the whole bladder and produces perforation. This ulceration is usually marked by vesical hæmorrhage and by acute localised agony in the part affected, much aggravated by the contact of instruments. I remember meeting with it once in a case of stone, where it persisted long after the removal of the calculus (which was a very small one) by a single sitting of lithotrity, and ultimately proved fatal by pyæmia.

Contraction and dilatation of the bladder.

In these cases of cystitis with hypertrophy the cavity of the bladder is usually contracted, and often very much so. But there are many cases of passive obstruction in which, on the contrary, the bladder is simply distended and much thinned. 'This condition occurs not in stricture, but in those cases of enlarged prostate where, by reason of the size of the prostatic mass implicating the muscular apparatus at the neck of the bladder, the viscus is incapacitated from contracting and suffers passive distension.'—Thompson.

Treatment.

The treatment of cystitis, like that of all surgical affections, to be rational and successful, must be guided by a knowledge of its cause. In the rare cases where no cause can be ascertained, the treatment must be directed to soothing irritation and removing pain. For these purposes rest in the horizontal posture, warm fomentations, warm hip-baths, and opiates by the mouth or as suppositories are very useful. In acute or subacute cases the application of leeches or cupping the perinæum is extremely beneficial. The bowels are to be kept open without purging. Hyoscyamus in large doses is often of great service. The other medical means must be regulated by the acuteness of the attack and the condition of the urine. If the latter be acid and the attack moderately acute, no good can be done by local interference, nor by the administration of the mineral acids; in fact, alkaline carbonates may sometimes be given with advantage.

But in ordinary cases the attack is not acute, nor is there any doubt about its cause. The presence of a stricture, an enlarged prostate, a stone, a gonorrhœa, or an injury of the spine at once points out that the cystitis is but a symptom, and that its cure must depend on the surgeon's success in removing the cause on which it depends. Still even when this is impossible, much, as Sir B. Brodie remarks, may be done towards relieving the affection of the bladder. In cases which are purely chronic, accompanied by copious secretion

of mucus, but with little irritation, and in which after death the bladder will be found rather dilated than contracted, and thin rather than hypertrophied, a condition to which the term catarrh of the bladder is properly applied, much good is done by washing the bladder out and by injections acidulated with nitric or sulphuric acid. The exhibition of diluent or demulcent draughts in tolerably large quantities, or in some cases the balsams or turpentines, is followed by improvement. In catarrh of the bladder the favourite remedies are the decoction of uva ursi, or pareira brava, or a combination of the two; in cases where there is somewhat more inflammation large doses of the decoction of triticum repens, or a smaller quantity of buchu may be given; alkalies and opiates being combined with these as circumstances demand. Sir H. Thompson quotes with approbation a prescription of Dr. Gross: one ounce and a half of the leaves of the uva ursi and half an ounce of hops are infused for two hours in two pints of boiling water, a wine-glassful to be taken several times a day. The mere demulcents are used chiefly as vehicles for other medicines and as diluting the urine: such as barley-water, gum-water, decoction of mallows or of Irish moss, linseed-tea, &c. Caution is to be observed in estimating the reaction of the urine. It does not follow because the urine when passing is alkaline that the secretion is alkaline. Acid urine coming into an inflamed and irritable bladder will cause it to secrete alkaline mucus, the decomposition of which soon turns the secretion alkaline. In such cases there is generally obstruction, and the secretion may be best made healthy by removing the obstruction, washing out the bladder, and administering a soluble alkali, such as the citrate of potash.

Opening the bladder in cystitis. (Cystotomy.)

There are cases in which the cavity of the bladder is extremely small and the calls to pass water consequently almost incessant,[1] and these are extremely difficult to treat in consequence of the intolerance of any local treatment by the irritable bladder. In some cases, where the frequency of micturition has been the leading symptom, the bladder still retaining a fair capacity, the surgeon has felt himself justified in cutting into the bladder, as in the operation of lithotomy, in order to ensure at any rate temporary rest to the inflamed organ, and the operation has been often useful, and particularly in females.[2] But in females all local measures are much more easy to carry out and much more likely to succeed, and in them, besides the necessary investigation into the general conditions of the system and the local condition of the bladder, the state of the uterus and vagina must be carefully examined, and any irregularity corrected.

Vesico-intestinal fistula.

This may be the place to mention the occasional (though fortunately rare) occurrence of a fistulous communication between the bladder and some part of the intestinal tube. This painful symptom is found usually in cancer, but there are instances (of which I have recorded a very remarkable one[3]) in which the formation of the opening seems due to common ulceration of the bowel or possibly of the bladder, though this latter is I think less probable. It occurs usually in the male sex, but sometimes also in the female. The communication

[1] In a case of this sort recorded by Dr. Dawson of Cincinnati in the 'N. Y. Archive of Clin. Surg.' vol. i. the patient used to pass water as often as 80 times in a day.

[2] I would refer on this head to a paper by Dr. R. F. Weir in the 'New York Med. Record,' June 12, 1880, in which a table is given of 47 cases of cystotomy in the male. In the only operation which I have myself performed the relief was great, and I had an opportunity of ascertaining that it persisted about two years after the operation.

[3] 'Med.-Chir. Trans.' vols. xlix. and l. See also Mr. Pennell's and Mr. Charles Hawkins's cases there referred to.

is either with the large or small intestine. The appearance and odour of the urine, and probably the pain in the part, first attract the patient's attention, and then the fæcal matter can be detected either with the eye or the microscope. As the opening enlarges, and especially when the large bowel is the seat of the fistula, masses of solid fæces pass into the bladder, causing obstruction of the urethra, and probably forming the nucleus of a phosphatic stone. In such cases the lumps must be broken up with a lithotrite; and if on careful examination the surgeon is satisfied that the communication is with the sigmoid flexure, the descending colon should be opened. This operation was performed in the case under my care, and with temporary success. The patient was much relieved, and was about to resume his ordinary avocations, when a relapse took place in an even severer form, and he died fourteen months after the operation. The cause of death was found to be the formation of a similar communication with the cæcum, the original opening between the bladder and sigmoid flexure having closed. A most interesting case under the care of Mr. Hakes of Liverpool will be found related in the 'Liverpool Medical and Surgical Reports,' vol. iii., and the 'Liverpool and Manchester Reports,' 1875, in which the patient survived five years. After his death the large intestine below the artificial anus was found to be absolutely impervious, and represented only by a fibro-areolar cord.

DISEASES OF THE PROSTATE.

Acute inflammation.

ACUTE inflammation of the prostate is generally a consequence of gonorrhœa, but may be caused also by injuries (one of the most frequent being rough catheterisation), by inflammation of the bladder, by stricture setting up inflammation of the urethra behind the obstruction, by the application of caustic, and by the lodgment of calculus.

The symptoms of acute prostatitis are rigors, feverishness, pain and irritation in making water, with frequent calls to do so, pain in defæcation, and pain radiating from the loins down the back, thighs, and perinæum. If there is any tendency to piles they will probably show themselves, on examination by the rectum, and this examination is found to be very painful; the prostate is swollen, hard, hot, and very tender; and if a catheter is passed, there is acute tenderness of the prostatic part of the urethra. There will probably be some pus in the urine from inflammation of the prostatic urethra, even irrespective of abscess, which, however, is very liable to form. This is marked by the continuance of the feverish condition for several days, with rigors, tension, and pulsation in the region of the perinæum and bladder. The difficulty of passing water will also probably increase. Examination with the finger will now prove that the hard prostatic tumour has given place to a soft swelling in which perhaps the surgeon may detect fluctuation, though from the awkward position in which it lies for palpation this is not always possible. These abscesses are not, however, always situated inside the capsule of the gland, for very similar symptoms are caused by suppuration around it—periprostatic abscess.

Prostatic abscess.

The diagnosis of acute prostatitis is not usually difficult if attention is paid to the course of the symptoms, and the disease usually has a favourable issue. It generally subsides of itself, on the withdrawal of irritation, or under treatment, or else runs on to abscess, which bursts, with free discharge into the urethra and a sudden relief to the symptoms. But things may not go on so happily. I have seen one striking case in which an abscess neglected and over-

into the stomach or applied as a blister. The bladder may also be inflamed by the spread of inflammation from a neighbouring organ, as in gonorrhœa or in inflammation of the prostate. Finally, direct mechanical violence, as in surgical operations, is a frequent cause of cystitis, and it may originate spontaneously, either from exposure to cold, or from tubercular irritation, or the softening of tubercular deposit, or from no known cause whatever.

Anatomy of cystitis.

Inflammation of the bladder commences always on its mucous surface, the membrane becoming so loaded with blood as to assume a dark purple colour, thickened and velvety, in some cases coated with adherent lymph and phosphatic deposit from the urine, in others ulcerated here and there. The irritation which accompanies it produces frequent and spasmodic muscular action. Often the cause of the affection involves obstruction, and consequently much straining to make water, and from these circumstances muscular hypertrophy is a constant phenomenon in cystitis, so that the muscular fibres stand out under the mucous surface somewhat like the columnæ carneæ of the heart, and they cross each other in every direction, leaving small spaces or alveoli between them. To this condition the terms 'columnar and fasciculated bladder' are applied. The mucous coat of the bladder is often protruded through the opening of these fasciculi, causing pouches which sometimes do not reach through the whole thickness of the walls of the bladder (Fig. 384), while at other times they form distinct and definite projections (Fig. 385), often of very large size. Similar and sometimes much larger pouches or cysts are found as congenital malformations (Fig. 355).

The symptoms of cystitis in the acute form are general fever, great pain in making water, frequency in micturition, bloody urine, soon turning purulent, pain and tenderness to pressure in the region of the bladder, and pain extending down the thigh and perinæum; often also the straining produces prolapsus or piles.

Formation of ropy mucus.

We commonly see, however, the less severe form, which is variously described as subacute or chronic, in which the mucous membrane of the bladder secretes an abundant deposit of alkaline mucus or muco-pus, and in which the urine is turbid and contains a variable quantity of a mortary deposit usually called 'ropy mucus.' This deposit is formed of phosphate of lime mixed with pus and mucus, and is very viscid, clinging to the vessel when inverted and slowly falling out in a mass. The supernatant urine, when examined by the microscope, usually is found to contain a good deal of pus, and the triple phosphate of ammonia and magnesia. This phosphate is also sometimes found mixed with the phosphate of lime in the sediment. The urine decomposes, becoming intensely alkaline and ammoniacal, whereas, when the mucus is only in small quantity, though the deposit is itself alkaline, the urine may be acid.[1] It appears, then, that the essential cause of the decomposition of the urine is the mixture with it of the alkaline mucus or muco-pus secreted by the walls of the bladder; and this decomposition is connected, at any rate by some pathologists, with the chemical composition of urea. Thus, the formula for urea being $C_2 H_4 N_2 O_2$, its elements are exactly the same as those of carbonate of ammonia, minus 2 atoms of water. Thus, 2 atoms of carbonic acid $C_2 O_4$ + 2 atoms of ammonia $N_2 H_6$ = $C_2 O_4 N_2 H_6$ − deduct $O_2 H_2$ (2 atoms of water), and the result is as above. $C_2 H_4 N_2 O_2$, or one atom of urea. This decomposition readily ensues out of the body on heating urea with an alkali, and the decomposition of the urine is regarded (and certainly with the highest probability) as an analogous

[1] Sir B. Brodie's Works, vol. ii. p. 466.

Mr. Lee has lately published some interesting lectures on this topic, to which I would refer the reader.[1]

Enlarged prostate.

Enlargement of the prostate gland is an affection of old age; not that all, or the majority, of old people suffer from this affection; but that it only occurs after the middle of life.[2] It consists either of a hypertrophy of the prostate itself (Fig. 360), or of a tumour developed in the neighbourhood of the gland, but separated from it by a capsule of fibrous tissue (Fig. 359), or of a combination of the two. The enlargement very often affects the whole of the gland, sometimes only one side; sometimes it consists chiefly of an abnormal development of the central portion—the uvula vesicæ, or third lobe, as it is called. The separate tumours consist of tissue bearing great resemblance to that of the prostate itself, but not perfectly developed, just as in the adenoid tumours which have a similar relation to the female breast. Sometimes, as in Fig. 361, the enlarged prostate is also ulcerated on its surface, and often in old age either with or without such ulceration the veins around the prostate gland (prostatic plexus) become engorged and bleed into the bladder. I have seen the urine almost black with blood for many days together from this cause. Hæmorrhage from the prostate is easily known by the absence of stone, by the absence of all previous history and symptoms of cystitis, by the suddenness and copiousness of the bleeding (reminding one in this respect of epistaxis), and by the enlargement of the organ. It rarely requires any treatment. If it does, washing out the bladder with acidulated lotions, and the administration of internal styptics, as acetate of lead or gallic acid, would be indicated.



FIG. 359. A section of a prostate gland, in connection with which is a small tumour, separated from the rest of the gland by a definite capsule, and occupying the situation of the 'third lobe.' This tumour consisted of cæcal pouches filled with epithelium, and connected together by fine fibroid tissue. There were the usual symptoms of enlarged prostate. The bladder is seen to be much hypertrophied, and at the post-mortem examination was found full of purulent urine. The ureters, pelves, and infundibula of the kidneys were dilated, and the kidneys themselves contained numerous small abscesses. From the Museum of St. George's Hospital, Ser. xii. No. 112.

Prostatic hæmorrhage.

Symptoms of enlarged prostate.

The first effect produced by enlarged prostate is a certain degree of difficulty and straining in making water, which is most perceptible at the end of the evacuation. This is succeeded, if treatment be neglected, by chronic cystitis. For in all obstructions to the flow of urine, a certain amount being constantly left in the bladder, the walls of the bladder are continually irritated; the urine, as previously explained, becomes turbid and alkaline; the bladder is never fairly emptied, and some of the residue of the urine must always be left, by which the irritation is kept up and propagated.[3] Then, if the obstruction continues unrelieved, all the usual sequelæ may ensue: dilatation of the urinary passages, leading to uræmia; or inflammation of the ureters, and kidneys, leading to pyelitis; and in either case speedy death.

Diagnosis.

The diagnosis is generally very easy. The patient first believes himself to have stricture, and, of course, he may have both. But a case of uncomplicated enlargement of the prostate is very easily distinguished from one of stricture.

[1] 'Lectures on Syphilis,' &c., 1875. Lect. ix.

[2] The researches of Sir H. Thompson ('Syst. of Surg.' 3rd ed. vol. iii. p. 198) and of Dr. Messer render it probable that enlargement appreciable on dissection exists in about one-third, and enlargement causing symptoms in about one-tenth, of males over sixty.

[3] Surgical writers sometimes use language which conveys to students the idea that the same urine is constantly retained in the bladder. This, of course, can hardly be intended, but the bladder is excited to inflammation by its never being evacuated.

The patient's age and the absence of previous history of stricture makes the diagnosis of enlarged prostate most probable, and this is easily confirmed by examination from the rectum, when the enlarged prostate will be found as a hard tumour pressing down into the bowel; or by passing an instrument after the patient has made water, when it will be found that there is no obstacle till the point of the catheter passes under the pubes, when by depressing the handle between the patient's thighs the catheter can usually be easily made to ride over it, and all the more so if a full-sized instrument be used, which is, of course, the direct reverse of what is found in stricture. When the bladder is reached it will probably be found that the patient has not entirely emptied it.

Treatment.

Unless it has been long neglected, there is not usually much difficulty in dealing with prostatic enlargement. A catheter should be passed daily with all possible gentleness; if there is much muco-pus in the urine the bladder should be washed out; if the enlargement of the gland is considerable, as indicated by the large amount of residual urine in the bladder after the patient has emptied it of as much as he can, the catheter should be passed more frequently, two or three times a day, or even whenever the patient wishes to make water. When the water has become very foul the free injection and washing out of the bladder should not be neglected. The catheter should not be tied in unless there is unusual trouble in passing it. This treatment is palliative only, but I am under the impression that it does tend to prevent the further growth of the disease, which seems to be quickened by irritation. And it certainly saves the patient's life by obviating the various complications which otherwise ensue. But it is beyond the power of medicine to reduce the enlargement which has once formed.

Retention of urine in enlarged prostate.

Retention of urine often comes on so suddenly, and disappears so completely in enlarged prostate as to prove that it is caused by some sudden spasm, or enlargement, from hyperæmia of the gland. The cause is usually sexual intercourse, a debauch, exposure to cold, or urinary inflammation, the result of stricture or instrumentation. There is not usually any difficulty in passing an instrument and relieving the retention in a case of this kind, and then rest in bed with demulcents and opiates soon restores the patient to his former condition. In other cases the retention is so nearly constant as to show that it depends mainly on the size of the enlargement, and in such cases the retention if unrelieved soon passes into incontinence. Patients in this condition often believe that no instrumental treatment is required since they are always passing water, but of course no surgeon would fall into such a mistake.



FIG. 360. Bladder, symphysis pubis, and enormously enlarged prostate. A portion is removed from the front wall of the bladder, to show the vertical course of the urethra as it enters the bladder. After Sir H. Thompson.

It may sometimes be useful to a patient who suffers from frequent attacks of retention depending on prostatic enlargement to know that he can probably

relieve himself to some extent by placing himself on his hands and knees, though this should never encourage him to neglect the instrumental treatment which his case now urgently requires.

The prostatic catheter.

There are some cases (by no means as many as has been taught) in which the passage of an ordinary full-sized catheter is difficult. Sometimes this depends on lateral enlargement, which may be detected by exploration per rectum and an appropriate direction given to the instrument. At other times it depends on the urethra being really lengthened and pushed up into a somewhat vertical direction by the tumour. When this is the case a 'prostatic catheter' must be passed, in order to reach the bladder. This is longer and has a larger curve than the ordinary instrument.

Forced catheterisation.

These means will succeed in the great majority of cases. But there are some in which no dexterity will succeed in reaching the bladder, either from the extent of enlargement, or from the existence of false passages. In such cases it has been recommended (and the recommendation is endorsed by Sir B. Brodie, Works, ii. 527) to thrust the catheter through the substance of the prostate, as was done in the case from which Fig. 861 was taken. But this proceeding is now, I think, given up—at least, I have not of late years heard of its being done. In many such cases if the irritation be subdued by evacuating the distended bladder two or three times with the aspirator, treatment may be successfully resumed. In others a more permanent opening into the bladder must be made. When the enlargement is not too considerable and the bladder can be felt behind the prostate, most surgeons prefer to puncture from the rectum. I cannot say that this appears best to myself, since the puncture will only give temporary relief and the symptoms may recur. It is quite true that the irritation may subside or the false passages may heal, and then the surgeon may succeed again in passing the catheter. But the same advantages also attend what I conceive to be the better plan in these cases, viz. to puncture above the pubes.



Fig. 861. Great enlargement and ulceration of the prostate gland. Retention of urine having taken place it was relieved by forcibly thrusting a catheter through the substance of the prostate. A bougie is inserted in the artificial passage. A section has been made through one side of the enlarged prostate to show the extent of the hypertrophy.—From a preparation presented by Sir B. Brodie to the Museum of St. George's Hospital, Ser. xii. No. 109.

Puncture of the bladder above the pubes.

This is an operation of no difficulty, and I believe of little danger, when the bladder is fully distended. A puncture, or small incision, is made in the middle line immediately above the pubes; and the fat, if there is much, may be broken down with the director or handle of the knife. Then the finger will feel the fluctuating bladder and a common trochar and canula, or a curved one, if at hand, is passed in, and a piece of gum catheter passed through to steady it and prevent its slipping out. After about a week or ten days, when the track of the wound is consolidated, the instrument may be removed, cleaned, and changed. The advantage of this puncture is that the canula can be worn permanently with little or no inconvenience, if it is necessary. A canula provided with a shield and

stopcock is adapted, and the patient removes the plug when he wants to relieve his bladder. He is thus spared all the annoyance of instrumentation. The bladder, however, must be kept carefully washed out.

The only time I have as yet had occasion to perform this operation, the patient (who was in a very bad state at the time) survived, and I heard of him a year afterwards in good health and still wearing the canula.

Cancer of the prostate.

Cancer only rarely originates in the prostate gland, though its primary occurrence there is indisputable, and in some cases it remains confined to the organ. It gives rise to acute pain, hæmorrhage, and frequent micturition, in fact to many of the symptoms of stone, and in a well-marked instance which occurred in my own practice, it was not till after repeated examination, and under anæsthesia, that I fully satisfied myself of the absence of stone; but the distress is usually even more acute than in stone, and the wasting and loss of health are striking phenomena. There is more pain also in neighbouring parts than is usually felt in stone in the bladder. When the tumour has grown considerably it may be possible to assure oneself of its nature by examination from the rectum; but at first it will simulate the ordinary enlargement of advanced life, and these cases almost always occur after middle age.[1] The cancer is usually of the encephaloid variety, though in some cases it has been described as scirrhus, and it may spread to the neighbouring organs, or may affect the inguinal glands, or fragments of it may be found in the water—in any of which cases the diagnosis will be clear enough. Nothing can be done except to palliate the patient's sufferings as best may be.

Other affections of the prostate.

Tubercle is found in the prostate in cases where the whole urinary tract is affected, and cysts of the prostate are spoken of, but only as cavities formed by prostatic calculi, which will be described later on. Hydatids have been found lodged in the neighbourhood of the gland, and have produced retention of urine by pressing on the bladder; but the condition hardly allows of diagnosis before operation. The indication will be to open the bladder in the most accessible situation on failing to pass the catheter. Then the nature of the case will probably be recognised, when the hydatids must be freely evacuated by incision, and all remains of them frequently washed out.

DISEASES OF THE URETHRA.

Malformations.

THERE are cases of congenital obliteration of the urethra, but I am not aware that the deformity has been recognised during life. In fact, the infant generally dies very soon after birth, otherwise there could be no difficulty in cutting down to the seat of obstruction, and opening the posterior part of the urethra, which seems generally natural.

Hypospadias and epispadias.

But the malformations about which the surgeon is usually consulted are hypo- and epi-spadias. The former is, in its minor degrees, a very common malformation, and one of no consequence whatever. The urethra opens on the lower surface of the penis at some distance beyond the natural position of the meatus. When, as is most usual, this opening is only a little behind the glans the patient can pass water naturally, and in sexual intercourse the semen will be lodged fairly within the vagina, so that there is no motive for surgical interference. The prepuce also is in these cases usually somewhat misshaped.

[1] Sir H. Thompson says that it has also been noted in early childhood, but that no cases are on record between the ages of eight and forty-one.

forming merely a large flap on the dorsal surface of the glans, which falls into the skin of the penis on either side, but does not form a complete circle. Hypospadias, however, in its higher grades is a very serious infirmity. The urethra opens at the root of the penis, the urine runs down over the thighs, so that the patient is obliged to make water sitting, and the semen would be discharged externally, if the patient were capable of sexual intercourse; but this is seldom the case, for the penis is bound down to the scrotum by a firm band, which becomes very perceptible in erection, and the organ curves downwards, somewhat as in chordee. This band is probably the remnant of the undeveloped corpus spongiosum.

Elaborate attempts have been made to remedy this deformity by plastic operations, and with some success, though I am not aware whether complete success has as yet been obtained. Three several indications have to be fulfilled: (1) to liberate the penis, so that it may assume its natural direction when erect; (2) to form a new urethra, so that the urine and semen may find a channel to the glans; and (3) to close the original opening. The penis is accordingly dissected free of the scrotum, and raised up to the abdomen. The neighbouring skin is transplanted from the penis and scrotum in two layers laid on each other by their bleeding surfaces, and with the cutaneous surface of the inner flap turned towards the penis to form the new urethra, and after these flaps have adhered and are healed, the fistulous orifice is refreshed and united to the new urethra, a catheter being kept in the bladder. The attempt is worth making in healthy boys or young men, and it is said to have been so far successful that a patient previously unable to effect an entrance was rendered capable of sexual intercourse, but the fistulous orifice remained. I once tried the operation in early childhood, but should not feel disposed to repeat it at that age. A very guarded opinion must be given as to the possibility of an infant afflicted with this malformation ever being able to beget children.

The opposite malformation—epispadias—in which the urethra opens on the dorsal aspect of the penis, is very much rarer, and is generally accompanied with great general malformation of the rest of the external genitals. In its extreme degree it constitutes the extroversion of the bladder before spoken of. Attempts have been made here also to put the parts in a more natural condition by plastic operations. In fact, the operation which I performed for extroversion of the bladder was adapted from one which had been practised in epispadias. But it is very doubtful whether any good can be done in such cases.

Stricture of the urethra.

Stricture of the urethra is a disease which is very frequent in every rank of life, but of which the worst and most complicated examples are found amongst the poor, who do not understand the gravity of a complaint which is so insidious at first, and who very often have not the time or the means required for its successful treatment. I mention this, inasmuch as, like hernia and like many other surgical affections, stricture would not, generally speaking, prove formidable, certainly would very seldom lead to death, if it were made the subject of early and intelligent treatment.

Causes of stricture.

The cause of stricture is in general either a low inflammation of the submucous tissue of the urethra, or cicatrisation, the result of an injury. A very common cause of stricture seems to be the persistence of a neglected gonorrhœal discharge, and some surgeons believe (and certainly with much probability) that ulceration of the urethra in gonorrhœa, such as is known to

occur sometimes, may often prove the starting-point of cicatrisation, and so of stricture. However, speaking generally, it is impossible to prove anything of the kind; the urethra at the seat of stricture displays more or less of induration and thickening beneath its mucous surface, causing contraction of its canal, but no such definite band as we should expect to be the result of the cicatrisation of an ulcer. And though there can be no question that gonorrhœa is a frequent cause of stricture, yet in many cases of stricture it is impossible to trace any connection with gonorrhœa, or indeed any cause whatever.

Another cause of stricture may be syphilis. Fig. 363 is taken from a case in which the healing of a syphilitic sore led to stricture at the meatus, and I have introduced it also to show how great destruction is sometimes allowed to take place from a disease in itself very readily curable. The simplest means would, no doubt, have sufficed at first to cure this stricture, which was, nevertheless, permitted to lead, through years of agony, to the patient's death.

The most formidable kind of stricture is that which follows traumatic rupture of the wall of the urethra, after a fall or blow. This kind of stricture is generally in the part which passes below the arch of the pubes, although occasionally, from blows or wounds, it may occur elsewhere. The resulting cicatrix is usually very dense, hard, and contractile, so that even after complete dilatation it will recur again and again. It constantly leads to fistula in perinæo, and occasions death or serious complications, in spite of the most judicious treatment.



FIG. 362. Stricture of the urethra about three inches from the meatus urinarius, formed by a bridle which is seen crossing the canal. A bristle is passed in above and below this bridle; the dilatation of the canal behind the stricture will be noticed.—From a preparation presented by Sir B. Brodie to the Museum of St. George's Hospital. Ser. xii. No. 49.



FIG. 363. Stricture at the orifice of urethra, producing dilatation of the whole urethra, and extensive destruction with abscesses in the tissue of the penis, communicating with the ulcerated urethra. There were several perinæal abscesses. The bladder was enormously hypertrophied, and the kidneys were much altered. The urine was of course alkaline, loaded with mucus and pus. The patient died soon after his admission into the hospital. The stricture at the meatus is believed to have been caused by a syphilitic sore contracted two and a half years previously.—St. George's Hospital Museum, Ser. xii. No. 60.

Seat of stricture.

The most common seat of stricture is said by Sir B. Brodie to be the membranous portion of the urethra. The researches of Sir H. Thompson have, however, proved that in the majority of the specimens contained in museums the constriction is rather in the bulbous than in the membranous part, but it would be hardly possible to detect the difference during life. Any anterior part of the canal may be the seat of stricture, those at the meatus (Fig. 363) being generally the result of accidental circumstances. Fig. 362 shows a stricture in the spongy portion of the urethra, and when

this is the case it is very common to find another farther back. Stricture again is said to be met with at the prostatic portion or neck of the bladder, but its existence is denied by the best authors. Sir H. Thompson has never met with a case. Strictures are occasionally multiple. John Hunter speaks of having met with a case in which there were six, but it is rare to find more than two or three.

Forms of stricture.

The anatomical forms of stricture are various. Fig. 362 shows an example of what is sometimes called the 'bridle-stricture,' in which the obstacle is caused by a bridle or band stretched across the canal, which may with great probability be referred to past ulceration, as may also be those (of which, however, no example has fallen under my own notice) in which a lunated fold occupies a part of the circumference of the urethra, such as is often seen in the rectum after the healing of an ulcer. More commonly the obstruction is a mere narrowing of the canal at the part affected, as if by a diaphragm placed in it, the 'annular' stricture (Fig. 364). When this diaphragm extends for some distance under the mucous membrane on either side of the point of greatest obstruction, it is called the 'indurated annular stricture,' and when a considerable part of the canal is constricted it is denominated a 'tortuous' or a 'cartilaginous' stricture.

The practical importance of these distinctions is not very great, except in regard to the obstacles which may be experienced in the forcible dilatation of the stricture. But it must be allowed that so much is stricture (meaning thereby real organic material obstruction) complicated by spasmodic action of the muscles around the urethra, and of the muscular fibres which form part of it, that it is often very difficult to determine during life how far the obstruction occupies the walls of the tube, so that a stricture which during life had been supposed to extend over a long distance has been found after death to have been, mechanically speaking, insignificant.

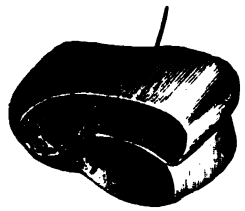


Fig. 364. Stricture of the urethra. About two-thirds of the tube is closed by a diaphragm of no great thickness, in which a small circular hole is seen, with a bristle passed through it. From a preparation in the Museum of St. George's Hospital, Ser. xii. No. 56A.

Symptoms of stricture and its sequelæ.

The symptoms of stricture are at first simply mechanical difficulty in making water and consequent prolongation of the length of time required to satisfy the calls of nature, with (as the disease advances) some straining, leading very likely to involuntary discharge of some of the contents of the bowel, and prolapsus. The patient often finds that after he thinks he has finished making water, more or less dribbles out, which has collected in the urethra behind the stricture, and is gradually forced through it by the action of the walls of that tube. Still, there is no evidence of any alteration in the parts not immediately implicated in the stricture, or any change in the functions; and the disease is, no doubt, easily under the control of treatment. But if it is neglected, other graver symptoms supervene, which are partly mechanical and partly vital. The difficulty in micturition may pass into total retention, or retention may come on from time to time after any excitement, and, with or without retention, very grave ulterior consequences may ensue. Any obstruction to the flow of urine will lead, as it would if the urinary tract were a piece of lifeless elastic tubing, to gradual loss of tone and distension of the part behind the obstruction. Thus, in every such obstruction, whether from impacted calculus (Fig. 387), stricture (Fig. 363), enlarged prostate (Fig. 359), tumour of the

bladder (Fig. 358), or any other cause, the consequences (apart from t results of vital irritability) would be dilatation of the part of the urethr behind the obstruction, of the bladder, of the ureters, and finally of t pelvis of the kidneys, leading to absorption of their cortical structure, su pension of the secretion, and death from uræmic poisoning. But thi supposes the absence of vital irritability, which is of course never entirel the case. Sometimes even in so muscular an organ as the bladder th effects of pressure overcome those of irritability, and it becomes distended and thinned. Even then, however, its walls are inflamed as well as thinned; but it is much more common in the bladder for the effects of irritation to overcome those of pressure, so that the walls of the bladder are thickened and fasciculated, and its cavity perhaps much diminished, or certainly not increased. In the urethra, on the contrary, which though muscular is much less so than the bladder, and which is exposed more directly to the action of pressure, there is almost always dilatation behind the stricture (unles relieved by ulceration behind the obstruction, leading to urinary fistula which in stricture of the meatus may involve the whole of the urethra (Fig. 363). But along with this, there is also inflammation of its walls, leading to ulceration and abscess round the urethra. In the ureters we commonly see only the effects of distension, the signs of inflammation being confined to some vascularity of the mucous membrane not usually perceptible after death. In some cases of obstruction, the kidneys will be found merely distended, with atrophied cortical structure and expanded pelvis. This state of things is not necessarily marked by any prominent symptoms before the fatal coma which precedes death from uræmic poisoning. But far more commonly, even in cases in which there is some amount of distension, the secreting structure of the kidney is also inflamed. The kidney is more vascular than usual, with deposits of yellow lymph and small abscesses scattered through its cortical part, and sometimes in fewer numbers in the cones, with thickened and adherent capsule, with distended tubes forming defined white lines in the cones, passing from the apex to the base of the pyramid, with distended and inflamed pelvis containing an offensive mixture of urine and pus, and with phosphatic deposits on the lining membrane. Dr. Dickinson and Dr. Wilks ('Lect. on Path. Anat.' by Wilks and Moxon, 1875, p. 500), have pointed out the identity of this 'pyelo-nephritis' in cases of pyæmia, of acute idiopathic cystitis and of obstruction or irritation in the urinary passages from surgical causes; and Dr. Dickinson, relying on the infarction of the minute veins of the medullary tissue which is found in these cases, and the distribution of the deposits of lymph and pus in the course of the vessels, believes that this condition is (as it were) a localised form of pyæmia—that is to say, that it begins by inflammation and obstruction of the minute vessels, provoked by the contact of decomposing urine, and leading to exudation into the parenchyma and suppuration, just as in secondary deposits.[1]

Effects of obstruction on the kidneys. So-called 'surgical kidney.'

[1] 'This disorder has its origin in the regurgitation of urine charged with morbific products. This, forced backwards by the retention general in these cases, distends or occupies the straight ducts. Thence, by transudation or similarly, it enters the neighbouring blood-vessels, and charges them with an infection resembling in its results that of pyæmia. This is distributed by the veins to the rest of the gland, sowing abscesses in their course, and ultimately causing constitutional symptoms analogous to those of pyæmia otherwise derived. The condition of the kidney may be described as one of pyæmia arising within itself'—Dickinson, 'Med.-Chir.' Trans. lvi. 227. Dr. Dickinson points out, however, that the materies morbi in this 'pyæmic' condition of the kidney is propagated by the veins, while in general pyæmia it is of course carried by the arteries.

ther observers have explained the suppuration as caused by the direct extension of inflammation (equally provoked by contact of decomposing urine) along the mucous surface of the pelvis and ducts of the kidney. The latter seems at first sight the more probable view; but the chief difficulty in accepting it (and which certainly lends great support to Dr. Dickinson's theory) is the impossibility, generally speaking, of tracing the continuity of the inflammation. The disease may be caused by anything which produces ammoniacal decomposition of the urine, but surgical causes, stricture especially, and also enlargement of the prostate, as causing obstruction, and stone in the bladder with the operations undertaken for its relief, as causing obstruction and irritation, are the most common. Retention of urine is a potent auxiliary in producing this renal affection, though it is not a necessary condition.

The symptoms are not very marked, and are, as Dr. Dickinson says, general rather than local; 'they point to contaminated blood rather than to disturbance of glandular function.' These symptoms are, pain in the loins, sometimes, shivering almost always, febrile symptoms always with rapid prostration, brown and dry tongue, sometimes frequent vomiting, hiccough, diarrhœa, profuse sweating, and later on yellow cadaverous complexion, low delirium, increasing unconsciousness, and ultimately complete coma and death. Erysipelas, pulmonary congestion, and sometimes distinct secondary deposits, are occasional complications. The fatal issue of the case usually takes place in about a fortnight after the first onset of these symptoms, but sometimes much earlier, and occasionally with extreme suddenness (as in the well-known case of the late Emperor Louis Napoleon); but the kidney-affection is said by the above acute observers not to be always fatal. The treatment can hardly amount to much. If stricture be the cause it may be thought justifiable to divide or rupture it, in order to wash out the bladder freely, and endeavour to correct the state of the urine. If it occur after lithotrity lithotomy may be risked in order to remove the fragments, and leave the bladder at rest—but the prognosis of the operation will be most gloomy. In idiopathic cases, or where there is no obstruction or foreign substance, little can be done beyond the administration of mineral or vegetable acids, with stimulants, and counter-irritation to the loins.

Complications of stricture.

Besides these fatal sequelæ of stricture there are various complications which must be noticed.

Fistula in perinæo.

The most frequent is *fistula in perinæo*, when the mucous surface of the urethra gives way behind the stricture, and allows the urine to make its way towards the surface gradually (the inflammatory condensation of the tissues around preventing extravasation of any large quantity of urine), until it burrows through the skin and the water passes through the unnatural channel sometimes wholly but more frequently in part, some of it escaping also from the meatus. There are often more than one and sometimes many such fistulæ, and they open not only in the perinæum but in the penis, scrotum, buttock, or groin also.

Urinary abscess.

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Extravasation of urine.

Or again, instead of merely giving way by a comparatively slow limited process of ulceration, the urethra may yield suddenly and entirely to the pressure,[1] when the urine is poured violently out into the tissue of the perinæum, scrotum, penis, &c. This is called *extravasation of urine*. If the stricture be in the spongy body (as in Fig. 862) the urine may be effused only into the penis, the perinæum being unaffected, but this is rare. Generally speaking, the stricture is at or about the bulb of the urethra, and the urine is effused between the triangular ligament (Camper's ligament or the superficial layer of the deep perinæal fascia) behind, and the deep layer of superficial fascia in front. As the latter membrane is attached on either side to the rami of the ischium and pubes, the effused fluid cannot pass on to the inner side of the thighs. The attachment of the same membrane to the deep fascia around the lower border of the transversus perinæi muscle prevents the urine from passing backwards to the anus and buttock. But there is no obstacle to its passing forwards to the scrotum, penis, and abdomen, and this is, accordingly, the path it takes. As the putrid urine comes into contact with the cellular tissue it sets up acute phlegmonous inflammation, rapidly running on to gangrene, with its usual concomitant of low typhoid surgical fever. At, or just below, Poupart's ligament, the superficial fascia of the abdomen adheres to the deep fascia, i.e. there is no subcutaneous cellular tissue, or very little, and there the inflammation ceases at least for a time. Ultimately, it is said, the adhesions which connect the deep and superficial fascia may be stretched and the inflammation creep down the thigh; but this must be very rare, as the patient usually dies if the inflammation does not stop before this takes place.

Rupture of the bladder.

Finally, a still more terrible catastrophe may occur, the rupture of the bladder, followed by extravasation of urine, probably into the peritoneal cavity, which is necessarily fatal—or into the pelvic cellular tissue, which in all probability will be so. This is a very rare effect of stricture, but undoubted examples of it are recorded.[2] It need not, however, be taken into account in the prognosis or treatment of a case, being altogether exceptional.

Treatment of stricture.

Although many of the above-described symptoms are vital, the origin and source of the disease is purely mechanical, and so must its treatment be at first. As a general rule, if an instrument can once be introduced through the stricture or strictures into the bladder, the case becomes at once amenable to treatment. Nor is there any difficulty in doing this in an uncomplicated case of recent spontaneous stricture. But in old neglected cases and in the worst forms of traumatic stricture it is exceedingly difficult, and in some cases impossible. To these cases the term 'impassable stricture' is applied.

In endeavouring to pass an instrument for the first time in any case of stricture its features should first be carefully studied. We should in the first place endeavour to exclude the idea of mere spasm, or what is called spasmodic stricture (p. 821), or of mere prostatic enlargement (p. 797), and satisfy ourselves that the case is one really of organic stricture. A reference to the above pages will indicate the diagnostic symptoms. The urine should be examined (if the patient can pass any) to show the state of the bladder; and the condition of that organ as to distension should be carefully ascertained. When the bladder is considerably distended it rises up from

[1] This is often accompanied by a feeling of sudden relief to the painful sensation of straining under which the patient has been suffering, and a deceptive lull occurs.

[2] One case is recorded (Harrison, 'Disorders of the Urinary Organs,' p. 32), in which the bladder seems to have been ruptured in retention from spasm.

the pelvis into the abdomen, forming a definite rounded tumour, perfectly dull to percussion, and sometimes rather sensitive to pressure, which may reach up as far as the umbilicus, and which can be felt in the rectum (unless the prostate is very much enlarged), and fluctuation can be communicated to the finger in the rectum by tapping on the abdominal tumour. When, on the contrary, the abdominal muscles are merely rigid from spasm (a condition not unfrequently mistaken for distension of the bladder), all these symptoms are absent except the sensation of resistance above the pubes. There is no definite rounded tumour, no dulness on percussion, no projection in the rectum, and, of course, no fluctuation there. Examination of distended bladder.

Besides the above points, it is desirable (if the patient is a person whose answers can be trusted) to know what has been about the usual size of the stream latterly and what it is now, since, if there is a great difference within a very short time it may fairly be conjectured that a good deal of the dysuria depends on spasm. It is also important to ascertain what, if any, attempts have been made already to pass an instrument, and whether they have been accompanied by much pain and bleeding, in which case the existence of a false passage may be suspected if the instrument failed to draw off the water.

When the surgeon has reason to diagnose the existence of organic or permanent stricture, an instrument should be passed at the earliest convenient moment. This need not necessarily be immediately after the case is seen, for if there is no retention of urine, an interval of rest in bed, with a warm bath every night, and abstinence from any recent cause of excitement, may form a good preparative, and facilitate the introduction of the catheter or bougie. Catheterisation.

Surgeons vary as to the kind of instrument which they habitually employ at the commencement of a case of stricture. Some prefer the common metal catheter, others the gum catheter with or without stilet, others a probe-pointed or simple or flexible bougie, others a solid metal bougie. The matter is more one of individual preference and of habit than of rule, and is hardly fit for discussion in an elementary work.[1] But whatever instrument is used, dexterity in its management and the utmost gentleness in its introduction are essential, both to the comfort of the patient and to the success of the treatment. Dexterity can only be acquired by practice, and therefore it is of the utmost importance for students to embrace every opportunity of practising the passing of catheters on the dead subject and on those who require the passage of a catheter without any obstruction, before undertaking the treatment of a really difficult case. In the natural condition of things there are only two material obstacles to the introduction of an instrument, viz. hitching the point in one of the lacunæ of the urethra, and pressing it against the triangular ligament as the point dips under the pubes. The former hitch occurs at any part of the spongy portion, very commonly near the meatus. Both can easily be overcome by withdrawing the instrument a little and allowing it to find its own way without the use of any force. In dexterous hands a solid instrument, or even a metal catheter, appears rather to drop into the bladder by its own weight than to be pushed into it; and this dexterity is

[1] At the risk of being considered old-fashioned, I will say that I believe the common metal catheters, if only they be used with proper gentleness and dexterity, superior for general utility to any other form of instrument, and next to them the common gum catheters; that I see little use in conical bougies (except in rare cases), and still less in probe-pointed instruments, bougies à boule, &c. But all this is mere matter of habit and opinion, and, to a certain extent, of fashion.

very well acquired by practising on the dead subject until the art of passing the catheter easily with one hand is perfectly familiar. Though the difficulty from spasm and pain does not exist in the dead subject, yet the laxity of the tissues causes a difficulty of its own, and if a man can pass instruments with perfect ease on the dead, he has gained a most important advantage for commencing his practice on the living.

Besides these merely mechanical obstacles, however, there is the difficulty resulting, particularly in nervous persons, from real or apprehended pain, throwing the muscles around the membranous part of the urethra into spasmodic action. This sometimes produces contraction of other parts of the canal; but as a rule the spasmodic resistance is not met with till the point of the catheter passes under the pubes. If the instrument be gently held (rather than pressed) against the contracted part of the tube the spasm will probably soon relax and the instrument jump into the bladder. In difficult cases, whether of stricture or enlarged prostate, much assistance will be obtained from passing the left forefinger into the rectum to ascertain the position of the point of the catheter and to guide it. Catheters are passed either in the erect or recumbent position. This depends in a great measure on the circumstances of the case and the habitual practice of the surgeon. Most surgeons prefer to pass instruments with the patient standing against the wall, perfectly erect, with his feet resting against the wall, and the surgeon seated in front of him, but if the patient is nervous or unaccustomed to instruments he may easily faint, and the surgeon must be prepared for that event.

False passage.

When after experiencing some resistance the instrument is pressed forward, makes a sudden jump and remains fixed, while the patient complains of pain and loses some blood, the surgeon may conclude that a 'false passage' has been made. No further attempt to pass an instrument should be made for a few days under these circumstances. It is rare for any formidable symptoms to ensue, for the false passage, being valvular towards the bladder, the urine does not find its way into it, and there is seldom any serious bleeding.

My own practice in commencing the treatment of a case of stricture is first to use a very small gum catheter without a stilet. If this passes easily I take a larger size, until the measure of the stricture is taken. If it passes, but with much difficulty, it is best, if circumstances permit, to tie it in for a couple of days or so. If this is tolerated, the case will be found much more tractable.

Gradual and rapid dilatation of stricture.

The two most common plans of treatment are by gradual and by rapid dilatation. In the former, after an instrument has been passed once or twice on successive or alternate days, the next larger size is taken, and so on until in a few weeks the stricture is dilated so as to admit a catheter the natural size of the tube. This size of course varies in different persons. In practice the No. 10 of our ordinary English scale may be taken as an average.[1] The patient is then taught to pass a similar catheter for himself, and the surgeon gives him such directions as to the frequency of passing it as he thinks fit, once or twice a week, according to the apparent tendency of the stricture to

[1] The normal calibre of the male urethra is generally believed to be represented by a tube about one inch in circumference. Dr. Fessenden N. Otis of New York believes that this is too low. He says that he has met with two cases in which calculi measuring 1⅜ in. in their largest and 1¼ to 1⅜ in. in their smallest circumference passed without any incision, and that he has measured urethræ even larger than this. He also figures an instrument for measuring the size of the urethra behind the meatus.—'Lancet,' July 11, 1874. But in practice the patient may be well satisfied when even No. 8 can be easily introduced. Some surgeons, however, teach that dilatation ought in all cases to be carried as far as No. 12.

contract: and he is to be told that although after a few years it may no longer be necessary to do this so often, yet that it is dangerous to neglect the occasional passage of an instrument in order to ascertain whether there is any tendency to renewed contraction, on the first suspicion of which he should immediately consult a surgeon.[1]

Rapid dilatation of stricture.

The other method, by rapid dilatation, is one which has been long a favourite plan of treating stricture at St. George's Hospital, and which Mr. Savory has recently strongly recommended from his experience at St. Bartholomew's.[2] It is a very convenient and very rapid method of treating cases in which confinement to bed is not objected to; and is therefore peculiarly appropriate to hospital practice. As much progress may often be made in the dilatation of a stricture in ten days by this method as would have been obtained in a month by that of gradual dilatation. I cannot better describe the plan than in Mr. Savory's words:—

'After an instrument has been introduced and secured the patient should, of course, lie quiet—in the great majority of cases he will rest most comfortably on his back. It is well to move it slightly and very gently in the urethra from time to time. This gives the surgeon additional assurance that all is right, and tells him at once the degree of progress that has been made by the loosening of the stricture. The instrument may be either withdrawn at the end of twenty-four hours, and one a size larger introduced, or it may be left for two or three days, when it may be replaced by a much larger one. As a rule I change the first instrument, if it be a small one (No. 1, 2, or 3), at the end of twenty-four or forty-eight hours, when I can usually pass No. 4 or 5, leaving that in for two or three days, when No. 7, 8, or 9 can be easily substituted. As to change of instrument, I am chiefly guided by the size of the catheter and the amount of suffering experienced by the patient. A large instrument may be retained longer than a small one, and the withdrawal of the original instrument and the substitution of another often gives relief when the patient is restless. Of course, patients vary much in their ability to bear a catheter in the urethra. To some it seems to give little or no trouble; they make no complaint, feed and sleep well, and, in short, give no signs of disturbance of any kind; while others complain very loudly, declare their utter inability to bear the instrument any longer, and urgently demand its withdrawal, sometimes withdrawing it themselves. In my experience these latter cases form the exception to the rule, and even in these I think the difficulty may usually be overcome. In the worst cases of stricture, where only the smallest instruments can be passed, the chief difficulty in treatment is overcome if an instrument can be retained for twenty-four or forty-eight hours.

'In my opinion the mode of action of this plan of treatment contrasts favourably with that of any other. The stricture is overcome—the abnormal tissue is removed—by constant pressure. The great influence of pressure in producing absorption is a well-recognised fact. We are familiar not only with many physiological, but also with many pathological illustrations of its

[1] Much has been said of late by those who advocate the frequent resort to operative interference as to the permanence of the cure after such operation. I can only say that no evidence has up to the present time been adduced (as far as I know) to invalidate the following opinion of an excellent recent author: 'You may exercise pressure upon it (i.e. the deposit which forms the stricture), you may divide it with the knife, or act upon it with caustics, but you cannot entirely remove it, or deprive it of its inherent quality of contraction.' R. Harrison, 'Lectures on Disorders of the Urinary Organs,' p. 29.

[2] See 'St. Barth.'s Hosp. Reports,' vol. ix.

potency. And it comes in very happily for the remedy of stricture. When an instrument is then introduced it is tightly grasped by the contracted portion of the canal, but is loose and free elsewhere, so that pressure is brought to bear at the very spot where it is required, and there only; and in proportion to the amount of good effected is the degree of its action reduced. It acts not by mechanical force, but by a physiological process. Of all methods of treatment this undoes the mischief in the most natural manner; and herein, I submit, is its claim to be considered the best.'

The drawbacks of the plan, besides the confinement which it entails, are that in some patients the retention of the instrument causes pain and inflammation, and that frequently, if after-treatment be neglected, the recontraction is even more rapid than the dilatation has been. But the former danger can easily be guarded against by carefully watching the case, and withdrawing the catheter if it really seems to be setting up mischief, of which the condition of the urine will be even a more trustworthy guide than the complaints of the patient. And the tendency to recontraction after cure can easily be obviated by a somewhat more frequent passage of the catheter than is needed after gradual dilatation.

Method of tying a catheter in the bladder.

A few directions are needed as to the mode of tying in a catheter. This can be done in various ways. The easiest, though not the most secure, is to tie a tape round the end of the catheter with a clove-hitch, or to pass tapes through the rings made on the ends of catheters which are intended to be retained, and then to secure the ends of the tapes under one or two pieces of strapping rolled circularly round the penis. The insecurity of this plan depends on the loosening of the strapping by the various conditions of erection and flaccidity of the penis.[1] A more secure plan is to pass the tapes which hold the catheter through the substance of a T-bandage, or of a broader piece of tape arranged after the manner of a T-bandage. The tape attached to the catheter ought to be loose enough to allow the instrument a little movement in the bladder, but tight enough not to permit it to slip out. The T-bandage should be as tight as is comfortable to the patient.

Mr. Savory believes that a silver instrument can be as conveniently retained as a gum catheter. My own inclines to the general opinion that a soft catheter is less irritating than a metallic one; but the difference is certainly not very great.

The same instrument should not be left in the bladder too long. I once saw a case in which the prolonged retention of a metal catheter in the bladder caused ulceration of its coats and perforation leading into the peritoneal cavity. This is of course very rare, but it is very common to see a catheter become coated with phosphatic deposits, and this increases the irritation of the bladder.

So much for the treatment of strictures in which the catheter can be passed.

Treatment of impassable stricture.

Should the surgeon be unable to pass any instrument, the treatment of the case will vary according as there is or is not retention. When there is not, the attempt will be put off till another day, the patient being prepared for the renewed attempt as above prescribed (p. 807). But if he is suffering from retention of urine, unless the bladder be distended to an alarming extent, a full dose of laudanum (say 30 or 40 drops) should be given in a little hot water, and he should be put into a hot bath until he begins to feel

[1] For private patients who have to wear a catheter, a little apparatus is sold to buckle round the penis, with rings to which the catheter is attached.

faint. Then if the retention has been relieved in the bath (which is often the case) he should be put to bed and left quiet till another day, otherwise the surgeon should try to introduce the catheter while the patient is still in the bath. If this attempt also fails, careful examination is to be made to ascertain how far the distension of the bladder has gone, and whether there is any sign of fulness or great pain in the perinæum. If not, the same measures may be repeated, and I have seen cases treated with success after numerous repetitions of such attempts; but they are of course not free from the risk of extravasation of urine occurring unexpectedly, on which account Mr. Cock[1] recommended the puncture of the bladder per rectum in preference to perseverance in the attempt to pass the catheter when a patient and sufficient trial has proved fruitless. At any rate, at some period or other, surgical relief must be given. Three courses are open—to puncture the distended bladder from the rectum or above the pubes, or to force a way into it with the catheter. The latter ('forced catheterisation') is no longer employed, except possibly by some surgeons in cases of great enlargement of the prostate, under which heading it has been discussed.

Puncture of the bladder from the rectum

Puncture of the bladder from the rectum is a simple operation, and in the cases which I have seen it has proved quite as successful as the condition of the patients permitted. It is to be employed in impassable strictures at such a time as in the judgment of the surgeon is desirable. It must be remembered that, even allowing that ultimately the retention of urine may be relieved, whether instrumentally or otherwise, before extravasation occurs, this argument is not of itself conclusive, in order to show that the operation of puncture is not desirable, since every hour which elapses increases the patient's sufferings and the inflammation of the urinary organs, while the repose that follows the puncture is of course complete: and after the canula has been retained some time in the bladder, the stricture being no longer irritated by constant straining and the contact of putrefying urine, will probably become much more tractable. The matter must be left to the surgeon's judgment, weighing the circumstances of each case. The fact that no case of stricture had been admitted into St. George's Hospital which was held to require puncture by the rectum from the time of Sir E. Home down to the year 1852, when Mr. Cock's paper was read at the Medico-Chirurgical Society, certainly shows that the operation is not often rigidly necessary; while the fact that it has been very frequently performed there in the comparatively few years which have elapsed since that date proves that Mr. Cock succeeded in showing that in many cases, even if not rigidly necessary, its more early performance is advisable. The operation itself is done thus. The patient is put up in the lithotomy position and had better be narcotised. The surgeon, being provided with a curved trocar and canula made for the purpose, examines the bladder with his left forefinger in the rectum in order to define the posterior border of the prostate gland, and to make himself sure that the fluctuation of the urine in the bladder can be felt with that finger when percussion is made on the bladder above the pubes. Having ascertained this beyond doubt, he passes the canula, without the trocar, up the rectum and fixes it with his left forefinger just behind the prostate on the place where the fluctuation of the bladder is felt. His assistant holds the shield of the canula in this exact position while he takes the trocar, passes it through the canula, and then drives it into the bladder with a decisive plunge, as though he wished to bring it out through the abdominal wall

[1] 'Med.-Chir. Trans.' vol. xxxv. p. 153.

above the pubes. There can be no risk in plunging it in boldly, if the bladder is well distended, while if it be more gently introduced it may either not perforate the bladder at all, or to so short a distance as to slip away again readily. It is well to pass a long piece of gum catheter through the canula in order to fix it more securely in the bladder, and it is to be tied-in in much the same way as a catheter (see p. 810). The canula is not to be stopped, but the urine can be conducted into a vessel below the bed by fixing an india-rubber tube to it; otherwise it must soak into oakum or tow, which is to be frequently changed. After seven to ten days a cautious attempt should be again made to pass the catheter, and if this is successful the canula is to be withdrawn; otherwise it may be left even for as long as a month. In a case under my own care, however, it became necessary to withdraw it after about three weeks, in consequence of the diarrhœa caused by the dribbling of water into the rectum, although no instrument could be introduced. The patient, however, was relieved of his retention and was satisfied with this relief, and so I lost sight of him.

Puncture of the bladder above the pubes is not usually necessary in cases of stricture unless when they are complicated with extreme enlargement of the prostate gland. Moderate enlargement of the prostate does not preclude the possibility of puncture per rectum, as shown by a preparation in the Museum of St. George's Hospital from a patient of Mr. Tatum, in whom the canula slipped out accidentally and the puncture was repeated. No difficulty was experienced either time, though there was considerable enlargement of the prostate gland. The operation of puncture above the pubes has been described in speaking of enlarged prostate.

The aspirator for puncture of the bladder.

The aspirator has of late been often used for the relief of stricture, by evacuating the bladder above the pubes. The method is more adapted to retention coming on suddenly from 'congestion' or 'spasm,' in cases of stricture not previously very severe, than in those of formidable organic stricture, but in appropriate cases I have seen much benefit from it. The puncture entails, as far as I know, no danger.[1] It relieves the patient from the pain of the retention, and takes off from the stricture the irritation caused by straining and by the pressure of the putrefying urine.[2] In most cases, the stricture becomes pervious after one or two punctures. If it does not, there can be no danger in repeating the puncture frequently, although the chance of relief in this way becomes less and less with each puncture. When the surgeon is convinced that some more effectual method is required, the operation of perinæal section is indicated. Our experience of suprapubic puncture at St. George's Hospital, however, as well as that published from other sources, has convinced me of the great value of this method of treatment, a method which has much limited the use of the more severe operative proceedings.

Treatment of impassable stricture where there is no retention.

Such is the treatment of impassable stricture when complicated with retention of urine. There are, however, strictures which the surgeon finds impassable, and yet there is no retention. In such cases much time and patience should be employed. Rest in bed, free purgation, and the constant use of the warm bath, will get the organs into a quiet state, and some day the surgeon

[1] In a recent case at St. George's Hospital, the patient was in a very weak condition and died a few days afterwards from bronchitis. The seat of the puncture was quite imperceptible.

[2] A case is recorded in the 'Brit. Med. Journ.' May 23, 1874, where the aspirator was used fifteen times, with immediate relief each time, and without any injurious after-consequences.

will almost certainly succeed in reaching the bladder—an attempt which is greatly facilitated by anæsthesia. But if he does not, what must be done?

The patient is, perhaps, free from retention, while quiet, but is liable to it at any time after exercise, exposure to weather, drinking, or sexual intercourse, and his life is made a torment to him by constant ineffectual instrumentation. For such cases the most radical cure is the old operation for stricture called 'la boutonnière,' or perinæal section, which must be carefully distinguished from Syme's operation, or external urethrotomy on a grooved staff, an operation which can only be performed when the stricture is *not* impassable.[1]

Perinæal section.

The operation of perinæal section is thus performed. The patient is to be secured in the lithotomy position, the perinæum having been shaved. A large grooved staff is to be passed down to the anterior face of the stricture and carefully maintained in position by an assistant. If a false passage is known or suspected to exist, the surgeon must take the greatest care to ascertain that the staff has not passed down it, but is in the middle line, i.e. in the urethra. If there is a fistula in perinæo through which a director or female catheter can be passed into the bladder, as is often the case, it facilitates the operation very materially.

An incision should now be made in the raphé of the perinæum in nearly its whole extent. As the incision must deepen at its lower part, it saves time and lessens the risk of losing the middle line to make this incision boldly by placing the left forefinger in the rectum as a guide; then plunging the knife with its edge upwards deep into the perinæum above the finger, so as just to avoid the rectum, and cutting out to the skin. The staff is then to be exposed by reversing the knife and dissecting carefully until its point is reached. Now commences the difficult part of the operation—the attempt to find the posterior part of the urethra by a dissection conducted along the course of the canal. If there is an instrument passed through a fistulous passage into the bladder, the posterior part of the urethra cannot of course be missed, but it does not follow that the dissection will be conducted along the urethra—still less when there is no such guide. Indeed, I have seen, after death from this operation, anatomical evidence that the surgeon had made a kind of artificial urethra, i.e. had dissected along the side of the urethra, leaving the stricture on one side only very imperfectly, if at all, divided. The parts should of course be held asunder, and the urethra looked for as carefully as possible. But it is seldom possible to see any distinction between the structures, and the only precaution which can be taken is to keep steadily in the middle line until, possibly, a gush of urine takes place and the director can be passed into the bladder. In any case, even when the surgeon cannot assure himself of the position of the urethra, it is always easy to reach the neck of the bladder by putting the left forefinger on the edge of the subpubic ligament—always easily felt when the tissues of the perinæum have been divided deeply enough, and then entering the knife below it. And I have known a successful issue in such a case, though the surgeon has not been conscious of exposing the vesical portion of the urethra. When the director has been passed into the bladder, a catheter should if possible be conducted along it from the wound, and tied-in. If, however, it is not possible to get the catheter into the bladder at once, the operation may nevertheless be quite successful if only the

[1] Mr. Syme used to dwell with characteristic force on the fact, in which all surgeons of much experience in urinary diseases concur, that there are really very few strictures which are impassable, if only the surgeon is dexterous and patient. The necessity for perinæal section ought, to say the least, to occur very rarely.

stricture has been freely divided. The patient should be left alone for a few days, and when the parts have consolidated somewhat, but not so much as to oppose the obstacle of cicatrisation, an instrument will probably be easily passed under anæsthesia. I have followed this course with complete success. The instrument must be changed as often as necessary, at first, perhaps, every three days, and afterwards every five or seven (an anæsthetic being given, if it is absolutely required), until the parts have been completely cicatrised. And after this, as after every other method of dilating stricture, the dilatation must be maintained by the constant passage of instruments.

Cock's operation for stricture.

Mr. Cock has warmly advocated,[1] in cases of impermeable stricture, a proceeding which somewhat resembles the early steps of the operation for perinæal section, but which omits the division of the stricture. In this operation, the surgeon passes his left forefinger into the rectum and by a bold plunge of the knife, directed towards, but not to, the forefinger he endeavours to open the urethra just in front of or just in the prostate gland. This when the urethra is dilated behind the stricture is not very difficult—at least to a practised operator. Then (the finger still being retained in the rectum) a probe-pointed director is passed into the bladder, and a female catheter, or a canula, or perinæal catheter, is passed into the bladder, and secured there. In this way the irritation of the stricture is removed, and the latter may become permeable, and when it is cured in the ordinary way the fistulous opening in the perinæum may be allowed to close. But if the stricture remains impermeable, the perinæal opening must be maintained by passing a catheter through it at frequent intervals, and the patient must be condemned to pass his water through it during his whole life, 'the man's micturition being,' as Mr. Cock expresses it, 'assimilated to that of the other sex.' Sexual power will however remain (though of course not that of procreation), and Mr. Cock does not consider the persistence of the perinæal fistula as any serious inconvenience. I cannot profess any acquaintance with this operation. We have had a sufficiently favourable experience of the old operation for perinæal section, as described above, at St. George's Hospital, to adopt it in all cases similar to those which Mr. Cock refers to. It may very possibly involve greater danger to life; but it has the great advantage that when it succeeds (as in the large majority of men with tolerably healthy urinary organs it does) its success is complete, and there is no perinæal fistula, and no deprivation of fertility; besides which it often involves little more incision than Mr. Cock's operation does.[2]

Furneaux Jordan's operation.

Mr. Furneaux Jordan's proposal[3] rests on the same principle as Mr. Cock's. He makes a small incision into the distended urethra behind the stricture,

[1] 'Guy's Hospital Reports,' 1866. The same operation was, however, recommended and practised at an earlier period by Mr. Simon. See 'St. Thomas's Hospital Reports,' vol. x. p. 139; also 'Med. Times and Gaz.' April, 1852.

[2] The urinary organs of a patient who had been operated on many years previously by Mr. Cock were exhibited at one of our Societies some years ago. The urethra had been opened just behind the stricture, which was of very small extent, so that an incision of not more than a quarter of an inch forwards would have enabled the operator to open a healthy portion of the urethra.

[3] 'Brit. Med. Journ.' Nov. 9, 1872. The principle Mr. Furneaux Jordan advocates is that, in exceptional instances, the 'membranous' urethra in some cases, and the bladder in others, is readily opened from the rectum. Only a few lines of tissue separate the finger in the rectum from an instrument in the urethra, the tip of the finger being carried to the depression between the anal sphincter and the prostate gland. In some cases he has found the distended bladder itself coming down to the sphincter; here incision with a bistoury would be as safe as puncture with a trocar, and may be followed by the introduction of the finger and the passage of an instrument forwards from the internal meatus to the external.

which is felt with the finger from the rectum, and then guides a curved flexible bougie through the stricture from behind forwards.

Wheelhouse's operation.

Mr. Wheelhouse's method[1] of performing perinæal section appears certainly more precise and logical than the old method, which he justly characterises as 'haphazard.'

It requires for its performance only two special instruments, viz. a straight grooved staff terminating in a probe-point which curves slightly to the side opposite the groove, and a probe-pointed gorget. The groove on the staff stops short at least half an inch from the point. The steps of the operation are as follows: 1. To open the urethra well in front of the stricture—say half-an-inch from it. 2. From this opening to find the orifice of the stricture, pass a director through it, and divide it. 3. To guide a catheter through the stricture from the meatus. The probe-pointed staff is passed down to the stricture, and great care is to be taken that its point is kept in the middle line, resting on the face of the stricture, and is not passed down a false passage. Then the urethra is dissected clean, and opened in the groove of the staff down to the stop at the end of the groove. Now the edges of the opening in the urethra are seized on either side and held open by a pair of nibbed forceps on either side. Next the grooved staff is turned with its groove away from the operator, and withdrawn, till its probe-point, which hooks away from the groove, catches in the urethral incision and assists the forceps in drawing the walls of the urethra forwards. Now the surgeon has a fair view of the interior of the urethra close to the stricture, and can discover the opening of the stricture with a probe-pointed director which is to be passed through it into the bladder. The surgeon knows that he has reached the bladder by the free movement of the director. He now runs a straight blunt-pointed bistoury along the groove of the director till the stricture is completely divided. Then the probe-pointed gorget is run along the director into the bladder, as a guide to the catheter, which is then easily introduced. In this as in other forms of perinæal section it is of vital importance to see that the whole stricture is fairly and freely divided. The essential point of difference between this and the old operation obviously is the search for the opening of the stricture. Mr. Wheelhouse's description seems to imply that he has never failed to discover it. If the surgeon should be unable to effect this, the second object of the operation, the proceeding would not differ from the old 'boutonnière.'

Treatment of abscess in perinæo.

The complications of abscess and fistula in perinæo are unfortunately very common. The former, however, rarely leads in itself to any graver consequence than considerable pain to the patient and confinement to bed for a time. The abscess in perinæo is rarely of large size. It commonly forms a small, hard, and very painful lump in the central line, much too small and deep to permit any fluctuation to be felt, but known to be an abscess by the presence of stricture, by the pain, and usually also by rigors and other feverish symptoms. No time should be lost in laying it open; it would be very reprehensible to wait until the matter has come forward, and till the surgeon can feel fluctuation. The patient should be brought to the edge of the bed, placed in the lithotomy position, and a deep puncture should be made with a lancet or (better) with a scalpel, great care being taken to keep in the middle line,[2] when matter mixed with urine, and usually very foul, will be evacuated, to

[1] 'Brit. Med. Journ.' June 24, 1876.

[2] Perhaps I should rather have said in the raphé, for when extravasation or suppuration takes place on one side, the raphé may be pushed over towards the other side (Harrison Lectures, p. 25).

the great relief of the patient. It is undesirable to tease him at first with instruments. The urine very seldom comes through the wound, for though the abscess is formed by ulceration of the urethra, its small orifice is generally closed by inflammation, otherwise the pus would flow out by the urethra and there would be little pain and no pressure on the tube, or increase of dysuria. Even if urine do escape, the cure of the stricture will soon cure the fistula.

Treatment of fistula in perinæo.

Fistula in perinæo is generally the result of a much more chronic action than abscess. Their origin is in some sense the same, but the early stage of abscess is accompanied by more irritation, probably from the greater putridity of the urine: while the fistula results from the gradual extension of ulceration from the urethra to the surface with no increase of the obstruction, and few if any symptoms. These fistulæ accompany all kinds of tight strictures, but are particularly prone to accompany the traumatic, which are the tightest of all. They have been known in such cases to form the only channel for the urine, the urethra being absolutely obliterated. Such unnatural channels, however, can never properly replace the natural urethra; they are very liable to partial obstruction from sabulous deposit, causing low inflammation of the urethra and bladder behind them, and they are a source of great discomfort to the patient, by incapacitating him from passing water in the usual manner. Their cure is to be sought in the restoration of the proper channel for the urine, by passing catheters increasing gradually in size, or by otherwise dilating the urethra to its normal extent. When this is done, the fistula will generally close of itself. If it does not, the reason usually is that a drop of water passes into the urethral end of the fistula every now and then and keeps it irritated. The best way to prevent this is by instructing the patient in the use of the catheter till he can easily pass a full-sized instrument for himself. This he must do every time he wants to make water, and must stop the end of the catheter with his finger as he withdraws it, so that no drop of urine can get into the mouth of the fistula. This plan, if sedulously persevered in for a week or two, can hardly fail to cure the fistula, unless its persistence depends on the chronic thickening and low inflammation of its wall, in which case the tissue should be destroyed by passing a red-hot wire down the fistula, or by passing a wire down the fistula to meet a catheter passed into the urethra and then connecting the wire with the galvanic battery; or sometimes these fistulæ heal on the stimulation of their walls with the tinct. lyttæ, or by means of a probe coated with the nitrate of silver. Possibly in some of these cases a very free division of the strictured portion of the urethra, on Otis's method, so as to dilate it to the extreme capacity of the normal tube in front of it, will enable the fistulæ to heal.[1] In some very rare cases, a plastic operation may be justifiable. The tissue through which the fistula runs is laid open freely and deeply until the urethra is reached, a grooved staff having been previously passed. All the diseased tissue which can be recognised is pared away and the parts sewn together, a catheter being kept in the bladder. Such an operation, however, is very rarely indeed called for.

Urinary fistulæ may also be produced by other causes, such as the impaction of a foreign body, a wound, as in lithotomy, and in rare cases by the bursting of an abscess into the urethra. I once saw a very healthy-looking man with a large urethral fistula of which he could give no account, except that it appeared to him to have been produced by prolonged sitting on the driving box, and who certainly had no stricture. In some wounds or injuries

[1] Teevan, 'Clin. Soc. Trans.' vol. x.

of the urethra the tube becomes completely obliterated, and this gives rise to the most obstinate form of fistula.

Ante-scrotal fistula.

The most difficult form of urinary fistula to treat is that which opens in front of the scrotum, called on that account 'ante-scrotal' or 'penile fistula.' It is caused usually by syphilitic sores on the skin, which, having become phagedænic, have opened into the urethra, or by sloughing, the result of accident or extravasation of urine. The main obstacle to the closure of such fistulæ is the constant disturbance of their edges by the varying size of the penis in erection, and this is especially the case after plastic operations, for the sutures which have been put in seem to act as irritants, and the patient is very liable to frequent erections. Patience, however, on the part of the surgeon and the patient will usually procure their healing after repeated operations. I once saw a case of ante-scrotal fistula from injury, in which thirteen operations were practised, and ultimately the fistula was perfectly cured. In these cases it is well to dissect up the skin freely around the fistula and to make free lateral incisions, so that the edges of the incision may meet over the fistula without any tension whatever. It may even be necessary to transplant flaps from the neighbouring part of the penis, and to divide the prepuce freely from the glans, in order that the erection of the penis shall produce as little effect on the wound as possible. It seems best to make these flaps double, laying them one over the other as I have described in the operation for extroversion of the bladder (p. 787). Care should be taken to ascertain whether there is any contraction of the urethra, and if so to cure it previously. The wound is to be united either longitudinally or transversely, as may seem to produce least tension on the sutures. The evacuation of the urine is very troublesome after such operations. It is best on the whole, I think, for the surgeon himself to pass a metal instrument three times a day with all imaginable care not to disturb the sutures, and to stop the catheter while he withdraws it. If a catheter is tied in it irritates the wound, and the urine is apt to dribble away beside it.

Recurrent or resilient strictures.

There are cases of urinary fistula with stricture in which the stricture can be passed, but cannot be dilated. The patient suffers constantly from rigors[1] after the passage of the instrument, and any progress that may be made at one time is soon lost again. In such cases the stricture must be divided either by the internal or external urethrotomy.

Syme's operation, or external urethrotomy.

Syme's operation—that of external urethrotomy on a grooved staff—is thus performed. The patient being in the lithotomy position, a 'shouldered' staff is passed into the bladder, i.e. a staff which is narrower at the end than it is in the stem. We may suppose that the end which passes through the stricture into the bladder is the size of No. 1 or No. 2 catheter, while the stem is the size of No. 8 or No. 10. At the junction of the two parts there will be a projecting 'shoulder,' and this shoulder will necessarily be arrested by the mouth of the stricture. A groove commences on the shoulder, i.e. on the thicker part of the staff, and runs along the convexity of the staff though not

[1] These rigors are in some cases most distressing. They are apt to recur whenever an instrument is passed, accompanied by a definite and often considerable rise of temperature, and great malaise, a condition sometimes spoken of as 'urethral fever.' They are best avoided by giving the patient a glass of hot brandy and water with a full dose of laudanum in it, and wrapping him up warm in bed immediately after the passage of the instrument. When this feverish condition lasts long or is unusually severe, it may prove fatal—especially as these patients often have more or less disease of the kidneys. Quinine, or aconite if the patient be not much exhausted, are the favourite internal remedies, combined with alcoholic and diffusible stimulants, and hot fomentations to the perinæum.

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Syme's operation, or external urethrotomy.

Syme's operation—that of external urethrotomy on a grooved staff—is thus performed. The patient being in the lithotomy position, a 'shouldered' staff is passed into the bladder, i.e. a staff which is narrower at the end than it is in the stem. We may suppose that the end which passes through the stricture into the bladder is the size of No. 1 or No. 2 catheter, while the stem is the size of No. 8 or No. 10. At the junction of the two parts there will be a projecting 'shoulder,' and this shoulder will necessarily be arrested by the mouth of the stricture. A groove commences on the shoulder, i.e. on the thicker part of the staff, and runs along the convexity of the staff though not

[1] These rigors are in some cases most distressing. They are apt to recur whenever an instrument is passed, accompanied by a definite and often considerable rise of temperature, and great malaise, a condition sometimes spoken of as 'urethral fever.' They are best avoided by giving the patient a glass of hot brandy and water with a full dose of laudanum in it, and wrapping him up warm in bed immediately after the passage of the instrument. When this feverish condition lasts long or is unusually severe, it may prove fatal—especially as these patients often have more or less disease of the kidneys. Quinine, or aconite if the patient be not much exhausted, are the favourite internal remedies, combined with alcoholic and diffusible stimulants, and hot fomentations to the perinæum.

quite to the end. The surgeon passes his left forefinger into the rectum and passes the point of the knife, with its edge looking upwards, into the raphé of the perinæum a little above his finger, so as not to wound the rectum, but to open the perinæum deeply and almost expose the staff in the urethra at a single incision, which is to be drawn upwards nearly to the scrotum. The shouldered part of the staff with its groove will now be very perceptible in the wound, and should be further exposed if necessary by a few touches of the knife. Then the point of the knife is to be inserted in the commencement of the groove, where it is, of course, in front of the stricture, and the knife is to be steadily pushed along in the middle line, so long as any resistance is experienced. The staff is then to be pushed on until its thick portion will pass freely into the bladder. Great care must be given to this part of the operation, to see that the stricture has really been divided quite freely enough, for if this has not been effectually done, recurrence is almost certain. Then the staff is to be withdrawn and a full-sized gum catheter passed from the penis and tied in. There is sometimes a difficulty in introducing the catheter after the withdrawal of the staff. This may be obviated by passing a director from the wound into the bladder before the staff is withdrawn, or by the use of a staff in which the shouldered part screws on to the thin portion, and is unscrewed after the stricture has been divided, leaving the central part to serve as a conducting rod, over which a large catheter open at the end is passed down and the rod withdrawn. But after all it is not a point of very much importance whether a catheter be passed into the bladder immediately after the division of a stricture or no. In a few days, when the wounded parts have a little consolidated, there will be no difficulty in passing the instrument (under anæsthesia if necessary) if only the stricture has been freely divided.

Syme's operation is now used chiefly, if not entirely, in cases of very hard traumatic strictures complicated with fistulæ in perinæo. Such strictures are very difficult to treat by gradual dilatation, or by rupture, and are hardly amenable to internal division, though there is no harm in trying this if the surgeon thinks fit. But the free division of all the morbid tissue, and the constant retention of a large-sized instrument afterwards, certainly afford the best prospect of a cure, after which constant catheterisation must not, for many years at least, be neglected.

Rupture, or forcible dilatation, of stricture.

Another successful method of treating rebellious strictures which admit the introduction of a small instrument is by what is generally called in England 'rupture' of the stricture, and in France 'forced dilatation.' This, however, like every other violent method of treating stricture, should be reserved only for cases of exceptional occurrence, viz. those in which there is unusual suffering from catheterisation, or in which no progress can be made in dilating the stricture, or the patient suffers constantly afterwards from fever and rigors, or after dilatation the stricture immediately recontracts. Numerous plans have been devised for this end. At first, the simple plan was followed of passing a central rod and sliding over it tubes increasing in size till the desired dilatation was reached. This, however, is a very imperfect device, since the tube is liable to catch and tear the mucous membrane at the site of resistance. Two methods are now employed, in each of which a dilatable instrument is first passed, consisting of two blades, attached to each other at the point, but separable in the rest of their urethral portion and fastened on to a central rod. The dilatation is effected in the one case (Sir H. Thompson's plan) by turning a screw in the handle, which causes a small lever to project from the central stem and so drives the blades asunder. In the other, which is the one in common use, a tube is forced down over the central stem,

and thus separates the blades to the required extent. This instrument was invented by a French surgeon, M. Perrève, and has been somewhat modified and introduced into English practice by Mr. Holt, whose name it generally bears in this country. Mr. Richardson of Dublin and others have also modified Perrève's instrument. The great risk in the use of any of these instruments is that of passing it down a false passage. In these cases of obstinate stricture there are generally false passages, and sometimes the instrument slips into them so easily, and they run so much in the direction of the bladder, that it is very difficult to know whether the point is in the bladder or no unless the urine can be seen to escape. Accordingly Mr. Holt has had the stem of Perrève's instrument perforated, converting it into a minute tube, through which a drop of urine will escape unless (as frequently happens) the little hole is obstructed by clot; in that case the surgeon should not proceed farther, if there is any question about false passage, until by examination by the rectum and palpation of the abdomen he has completely satisfied himself that he is really in the bladder. The tube is to be applied to the central rod (the handle being opened for the purpose by removing all the screws), and driven smartly home, in doing which the stricture will be felt to give way. The instrument is then withdrawn with the tube still in it, and the urine is drawn off with a full-sized catheter. Two tubes are supplied with the instrument; if the larger one has been used, No. 10 will pass; if the smaller, No. 8. As a general rule the catheter should not be left in, but it is well to draw the water off, both as a proof that the stricture is properly dilated, and in order to spare the patient the pain of passing water soon after the operation. Chloroform may be given or no according to the wishes of the patient and the surgeon. In very tight and hard strictures it is perhaps necessary, and in all cases where the operation is really required it must be painful, though soon over. The patient should keep his bed for a couple of days, and then the catheter should be re-introduced and the case treated as an ordinary one of stricture which has been dilated up to that size. It is not always possible, or at least easy, to pass the same catheter as at the time of operation, but in all cases which I have seen (except one of traumatic stricture) the case was very easily managed afterwards.

In this proceeding it seems doubtful what is the real action generally on the stricture. We speak of it familiarly as 'rupture,' but there seems good reason to think that it is often little more than a forcible dilatation, or if there is any rupture it is confined to the submucous tissue, and there is no breach of surface in the urethra. If this is so, it evidently diminishes the risk of inflammation from foul urine being extravasated or passing over a raw surface. I have seen death after this operation, but it was in the person of a man whose urinary organs were in so advanced a condition of disease that he could not in any case have lived long.

Internal urethrotomy.

Another method of treating rebellious or contractile strictures is by internal division, and this is indubitably superior to rupture in stricture situated far forwards, and possibly in traumatic stricture; though it may be questionable whether in traumatic stricture not in the spongy body, the freer division produced by Syme's operation is not preferable. The general use of Syme's operation and of the method by forcible rupture renders the use of internal urethrotomy rare in this country. It is performed in two ways, i.e. by incising the stricture from behind forwards, or from before backwards. The former is the safer course, and the one usually followed. Many instruments have been invented for this purpose, but the one most in use is Civiale's,

which may be taken as the type of them all. The principle of all is that of the bistouri caché, i.e. a stem containing a knife which is projected by pressing on a handle. In Civiale's urethrotome the head of the instrument is bulbous, and in this bulb a small knife-blade is concealed. The position of the stricture is clearly ascertained, and it is felt by the bulb in passing through it. Then as the bulb is withdrawn the knife-blade is projected from it, and the whole tissue of the stricture is freely incised, the incision being directed by preference to the floor of the urethra, and care must be taken that the incision extends completely through the obstruction. After the division a full-sized catheter ought to pass easily, and it is well to retain it for the first twenty-four hours, and to pass instruments frequently afterwards.

Incisions from before backwards require a guide to be passed through the stricture. Maisonneuve's guide is a flexible filiform bougie, on the end of which a grooved rod is screwed. This bougie being passed through the stricture, the grooved rod is screwed on to it, and is passed on. The filiform bougie coils up in the bladder, and guides the rod down the urethra, through the mouth of the stricture. Then a semi-sharp lancet-shaped knife is passed down the groove, which incises or tears the stricture, but is not sharp enough to wound the normal urethra. Sir H. Thompson has devised a grooved catheter for the same purpose, along which a sheathed knife-blade is passed. When this comes to the point of resistance the knife is unsheathed and the stricture divided. A large gum catheter is then passed over the grooved conductor, and the latter withdrawn. Mr. Durham has devised an ingenious instrument in which four small scarificators are projected from an olive-shaped bulb, so as to enlarge the urethra in all directions. The bulb is then passed forwards till it is checked, when the scarification is repeated.[1]

The advantages claimed for internal incision over rupture are that its results are said to be more permanent. I have not sufficient experience of the matter to enable me to pronounce an opinion of my own. Sir H. Thompson, whose experience of internal urethrotomy extends to above 300 cases, recommends it 'for all non-dilatable strictures situated from two to four inches from the external meatus,' and for these somewhat rare cases I doubt not that it is both safe and easy; but for strictures situated behind the scrotum I should long hesitate before resorting to it, although I do not deny that in rare cases it may be required.[2] In any case it appears that the extent of the incision through the stricture is not in itself a matter of any great importance; but it is highly important to make sure that no part of the stricture is left undivided.

Otis's operation.

In connection with the treatment of stricture by internal urethrotomy a very interesting question has lately been raised by Dr. Otis of New York. This surgeon teaches that in all cases of long-continued gleet with contraction of the urethra, as evinced by difficulty in passing an instrument, stricture must ultimately result unless the normal size of the urethra (measured according to his method) is restored, for which purpose he recommends internal urethrotomy,[3] all the contracted parts of the urethra being divided. Mr. Berkeley Hill has given a trial to this method, and the result of his experience

[1] See a series of papers in the 'Brit. Med. Journ.,' March 16, 1878, read before the section of surgery at the Manchester meeting of the 'Brit. Med. Association' in 1877.

[2] I would refer the reader to a very interesting little treatise by Mr. Lund on Internal Urethrotomy. See also a clinical lecture by myself, 'Med. Times and Gaz.,' July 14, 1883, and Sir H. Thompson's 'Clinical Lectures on Diseases of the Urinary Organs,' 1882, lect. v.

[3] Dr. Otis's views and method may be seen described in the 'Brit. Med. Journ.,' Feb. 26 1876.

is certainly such as will discourage surgeons from acting on a theory which is altogether unproved, and which involves practice evidently dangerous in all cases and very often quite unsuccessful.[1]

Subcutaneous urethrotomy.

In some cases in which the limits of the hardened tissue forming the stricture can be felt distinctly under the skin, whether of the penis or perinæum, the stricture may be divided subcutaneously with a tenotome on a catheter staff, over which after the subcutaneous division of the constriction a large rigid catheter can be glided into the bladder. For a description of this operation I may refer the reader to a paper by Mr. Teevan in 'Clin. Trans.' vol. viii.

Spasmodic retention of urine.

The retention which proceeds from organic stricture is to be carefully distinguished from that which is due to spasm only. To the latter the somewhat incorrect term 'spasmodic stricture' is usually applied. 'Spasmodic retention,' or 'spasm of the urethra,' better expresses the nature of the case, since there is really no *stricture* in the proper sense of the term. I have already stated that much spasm almost always attends organic stricture, and therefore the retention of urine, as well as the difficulty in passing instruments, in cases of stricture, depends usually to a great extent on spasm induced by irritation of the stricture, or on congestion of the urethra at and near the stricture. But the cases here spoken of are unaccompanied, as far as is known, by any anatomical change in the tissue of the urethra. The causes of spasmodic retention are, gonorrhœa, excesses in drinking, prolonged voluntary retention, the use of cantharides or turpentine, surgical operations about the pelvis, and morbid conditions of the urine; but it occurs also from unknown causes.

It may be known from the retention which accompanies stricture or enlarged prostate by its sudden occurrence, micturition having been quite natural up to the time when retention took place; and from that caused by impaction of stone by direct examination. In some cases, as when retention complicates surgical operations, the history points out the nature of the case.

There is seldom any difficulty in passing a catheter, and as this settles the case at once, and spares the patient a good deal of time and some distress, it is better in ordinary cases to take a medium-sized gum catheter, and pass it rapidly. The muscles may, as it were, be taken by surprise, and the catheter reach the bladder at once. If not, the obstruction will be found to be at the point where the membranous part of the urethra is surrounded by its muscles, and gentle steady pressure for a few seconds will often carry the instrument in. If this attempt does not succeed, the patient should be put into a hot bath till he is nearly faint, having previously had a full dose of laudanum,[2] and then in almost all cases the spasm will yield. In some rare instances it may be desirable to administer an anæsthetic.

Retention of urine.

Retention of urine is, as will have been seen from the foregoing pages, and from the chapter on STONE, a common symptom of a variety of morbid states. In children it proceeds most commonly from impaction of a stone in the urethra, or from a ligature round the penis, and in very rare cases

[1] See Mr. Hill's account in the 'Lancet,' April 8, 1876.

[2] Sir H. Thompson says that the Tinct. Ferri Perchloridi in doses of 15 to 20 minims, administered four or six times at intervals of a quarter of an hour, will relieve the spasm. Cazenave recommends the introduction of a lump of ice into the rectum, and I have found this plan succeed.

from tumour of the bladder or urethra, or from abscess pressing on the urethra. In men stricture is by far the most common cause, though it may proceed from spasm, or from lacunar or other abscesses pressing on the urethra, from prostatitis, from stone, or from various general diseases. In old age retention is commonly associated with enlargement of the prostate.

In the female sex retention is generally due to nervous causes (hysterical retention) or to pressure (as in parturition). It may be caused by stone, and in some very rare cases has been known to be due to stricture. Stricture of the female urethra is an exceedingly rare affection, but does undoubtedly occur. Its usual cause is, I believe, injury in parturition or otherwise. Careful examination is necessary to distinguish it from hysterical retention. It is best treated by rupture or internal incision.

Stricture of the female urethra.

Retention from obstruction of any kind (spasmodic or otherwise) must be carefully distinguished in the first place from suppression (p. 786), and in the next place from the kind of retention which is caused by paralysis, and from the atony which follows over-distension. Both of these are succeeded by overflow of urine, a condition sometimes incorrectly spoken of as incontinence. There is no difficulty in distinguishing between retention from obstruction and that from paralysis. In the former, after the obstruction has been overcome, the bladder will discharge its contents with natural force. In the latter (which is very rare, and which is accompanied by other paralytic symptoms) the urine merely runs out under external pressure when the catheter is passed, but there is no muscular action in the bladder itself, and there is no obstacle whatever to account for the retention. Atony from over-distension occurs in numerous classes of obstruction, enlarged prostate, stricture, tumour, &c. After a certain amount of retention, the urine begins to dribble away from dilatation of the neck of the bladder. The treatment consists in relieving the obstruction and keeping the bladder constantly empty.

Retention distinguished from paralysis and from atony the result of over-distension.

Incontinence of urine is in the great majority of cases the result of overflow from distension, and ought not to be spoken of as a substantive disease at all, being merely a symptom of obstruction. At other times it means the overflow of paralysis, or of the irritability of the bladder so often connected with paralysis. Hence the first thing in the treatment of incontinence of urine in the adult is to ascertain whether there is not one of those two conditions present, which in the very great majority of cases there is.[1] A very few cases will remain in which the urine, though healthy, cannot be retained for any length of time in the bladder. This happens sometimes in persons broken down by sexual excesses, and in other morbid conditions of the nervous system. The treatment must be regulated by the apparent cause. In some very rare cases of prostatic enlargement incontinence is caused by the projection of the 'third lobe' into the neck of the bladder, keeping it constantly patulous, a condition for which there is no remedy.

Incontinence of urine.

But the condition of pure incontinence which is commonly met with is the juvenile incontinence, or 'enuresis' of childhood, much more commonly seen in boys than girls, in which the child becomes a nuisance to himself and everyone else by constantly wetting the bed, and in some severer cases cannot hold his urine in the daytime. In some very rare instances there is

Enuresis in childhood.

[1] 'There is no principle more important to remember in the treatment of diseases of the urinary organs than this, that an involuntary flow of urine in the adult indicates a distended, not an empty, bladder.'—Thompson.

also a similar incontinence of fæces. Yet there is no evidence of spinal disease, the urine is natural, and the child in other respects healthy, though many of these children are dull and stupid.

In many cases, no doubt, the habit is to be referred to mere wilfulness, and may be corrected by appropriate punishment, or by moral means. It is well known that it is very liable to spread in a school into which a case has once been admitted. But there are many cases in which the child is as desirous to get rid of the infirmity as anyone else can be, and I have seen more than one instance in which a ligature has been tied so tight round the penis as to cut into the urethra by a boy who was determined to rid himself of the habit. In these cases the first thing is to make sure of the absence of worms, then to see that the child is awoke every three hours and made to pass urine, to act freely on the skin, to give tonics, especially steel and strychnine, and to administer cold douches to the spine. Belladonna is the drug which in my experience has acted most favourably in these cases, beginning with $\frac{1}{8}$ of a grain of the extract three times a day, and raising the dose till the characteristic symptoms of poisoning (of which paralysis of the bladder is one) begin to show themselves. Other practitioners speak highly of chloral. Sir H. Thompson says that in obstinate cases the application of a solution of the nitrate of silver, 10 grains to the ounce, to the neck of the bladder, may be beneficial.

The complaint almost always subsides before the patient grows up.

I will merely add that I once saw a case in which the dilatation of the neck of the bladder by a stone projecting into the urethra was mistaken for juvenile incontinence. Of course such an error could only arise from want of examination.

CHAPTER XXXVIII.

CALCULUS.

STONE, whether in the kidney or bladder, is produced by the aggregation of some of the ordinary urinary deposits, which we may divide with Mr. Poland into two classes—those allied to the urates and derived from the organic constituents of the urine, and those derived from the inorganic salts of the urine—the phosphates and carbonates. A familiarity with the external appearance of these deposits in the urine, and with their microscopical characters, is necessary for any successful treatment of urinary diseases.

Lithates. Of these deposits the urates or lithates of ammonia and of soda are the most common. They form a variously coloured cloud in the urine, sometimes pure white, at others almost purple, most commonly yellowish-red, which generally clears entirely on being heated. Such deposits occur constantly as an occasional phenomenon in conditions of perfect health, especially in cold weather, and no importance is to be attributed to the circumstance. But their constant or habitual presence shows that either the digestive or cutaneous functions are disordered, and should induce a strict examination and proper eliminative measures.

The microscopical appearances of the lithates are that they either form a completely amorphous deposit, or that, as shown in Fig. 365, there are minute spheres, having protruded from them acicular spiculæ, which are regarded as being those of uric acid.

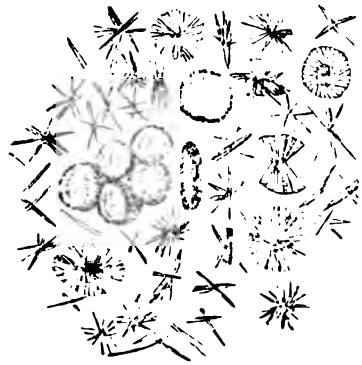


FIG. 365. Lithate of ammonia.



FIG. 366. Uric acid deposits.

Uric acid. Uric acid is also a very common deposit. It occurs in the form of acicular prisms or of rhombic plates, such as are shown in Fig. 366, and these often attain a very large size, so as to be perfectly visible to the eye as 'red sand,' or even to form a minute calculus. Dr. Golding Bird attributes the formation of uric acid deposits to the following causes: '(1) the waste of tissue being more rapid than the supply, as in fever, rheumatism, &c.; (2) the supply of nitrogen in the food being greater than is required for the reparation of the tissues, as in over-indulgence, especially in the use of animal food; (3) the process of digestion being insufficient to assimilate an ordinary

and normal supply of food, as in dyspepsia; (4) obstruction to the cutaneous outlet for nitrogenised secretions, as met with in diseases of the skin, variability of climate, &c.; (5) congestion of the kidneys from injury or disease.' Imperfect respiration is also said to be a cause of excess of uric acid in the urine. The treatment will be regulated by a knowledge of the causes.

Oxalate of lime is another common deposit in the urine, and often forms a calculus in the kidney or bladder. The microscopic appearances are two-fold—the octohedral crystals (shown on the left of the diagram) and the dumb-bell shaped crystals (on the right). The oxalic diathesis is variously regarded either as being allied to the lithic or the saccharine diathesis—to gout or diabetes. Its causes are either indigestion, exhaustion, or the abuse of saccharine food or fermented liquors. Attention to the cutaneous and digestive functions, the regulation of the diet, and the use of the mineral acids are the main indications of treatment.

Oxalate of lime.



Fig. 367. Oxalate of lime deposits.

The rarer deposits in our first class are the *uric* or *xanthic oxide*, which closely resembles uric acid, and the *cystic oxide* or *cystine*, which in external appearance resembles the pale lithates, and under the microscope appears as six-sided prisms superimposed on each other into a mass. This seems to indicate a more profound disturbance of health than the other deposits, and to require more supporting and tonic treatment.

The inorganic deposits are the phosphates and carbonates. The phosphates of soda or of soda and ammonia (alkaline phosphates) which exist in the urine are perfectly soluble and do not give rise to deposits or concretions; but the earthy phosphates—those of lime and of ammonia and magnesia—are insoluble in water, and when set free from their solution in the urine are easily thrown down. This precipitation is readily effected by ammonia; and we have seen above (page 792) that in inflammation of the bladder urea is converted into carbonate of ammonia by the agency of the mucus secreted by the bladder. Thus a deposit of phosphates is constant in inflammation of the bladder, and many of the numerous causes which diminish or destroy the proper proportion of acid in the urine, as inflammation of the kidney, spinal injury or disease, the ingestion of large quantities of alkali, nervous exhaustion, and many other morbid states produce phosphatic urine.

The deposit of phosphate of lime generally occurs as a white cloudy mass, often mistaken for mucus or muco-pus, and as it is precipitated by heat it is often hastily confounded with albumen; but the precipitate is redissolved by acids. It is generally amorphous under the microscope, but it is also found (especially after standing) in the form of spherules, which may coalesce into the form of dumb-bells, of glomeruli or rosettes, or of oblique hexagonal prisms (Fig. 368).

Phosphate of lime.

The triple phosphate of ammonia and magnesia forms large and very conspicuous crystals in the form of triangular prisms, with truncated extremities, or of foliaceous or stellate prisms (Fig. 369). The urine is often very fœtid, frequently acid or neutral.

Phosphate of ammonia and magnesia.

Mixed phosphates.

Both kinds of phosphatic deposit may be mixed in the urine, as they so commonly are in the formation of the fusible calculus.

Carbonate of lime.

The carbonate of lime is a rare deposit, which still more rarely collects into a calculus. Under the microscope the deposits may be seen as minute spherules which adhere together something like a drumstick.

These are the ordinary prismatic deposits, but the student must learn also to recognise the various other deposits found in the urine, such as the epithelium of the kidney or bladder, blood-cells, pus-globules, casts of the renal tubes, spermatozoa, and the various substances which are found in decomposing urine. It is most important to detect the presence of blood-globules, and still more so that of renal casts, as proof of disease of the kidneys.

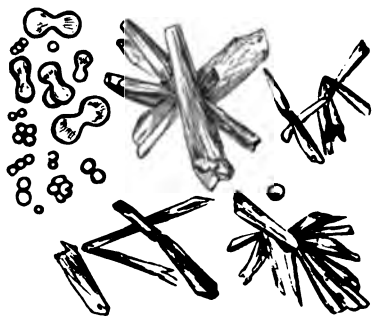


FIG. 368. Phosphate of lime.



FIG. 369. Triple phosphate.

Kinds of calculi.

The kinds of calculi correspond in a great measure to those of the deposits. They are commonly formed in the kidney, and come down into the bladder, where they grow, and sometimes to an enormous size. Sometimes they form in the bladder spontaneously, and at other times are deposited round a foreign body.

Lithate of ammonia.

Lithate or urate of ammonia seldom forms an entire calculus except in children, though it is often found as a deposit in the alternating calculi.



FIG. 370. Urate of ammonia calculus, from a child, aged five. It contains a little uric acid, and traces of earthy phosphates disposed in layers. - From one of Mr. Poland's plates in the 2nd ed. of the 'Syst. of Surg.'



FIG. 371. Uric acid calculus. The external part shows the laminated, the internal the foliaceous appearance. In the latter situation some oxalate of lime is mixed with the uric acid.—From a plate in Mr. Poland's essay, after a calculus in the Museum of the College of Surgeons.

Urate of ammonia calculi are of a whitish colour, and usually are of an amorphous non-laminated appearance.

Lithic acid.

The lithic or uric acid is the commonest of all forms of pure calculus. It is of a very hard consistence, and usually of a dark red or brownish colour though often the nucleus is pure white. The surface is tolerably smooth in

most cases. On section it is laminated or radiating (foliaceous). The laminated stones when broken are apt to separate into hard sharp fragments very liable to wound or irritate the bladder and urethra.

Oxalate of lime.

The oxalate of lime calculus is believed to be the next in frequency after the uric acid. Its peculiar form has given it the name of the mulberry calculus, from the number of small knobs or projections which are found on its exterior, and which certainly present a remarkable resemblance to a mulberry, and



FIG. 372. External view of a mulberry calculus.



FIG. 373. Oxalate of lime, or mulberry, calculus, showing its internal arrangement 'in an imperfect laminated manner, like fortification agate,' and the deposit of a white material, doubtless phosphates, in portions of its interior.— From one of Mr. Poland's plates.

this is increased by its colour, which usually 'varies from a grey to a rich brown or almost black.' This calculus forms, of course, in acid urine, but it often sets up a good deal of irritation, and then the urine becomes alkaline, and phosphates are deposited on the exterior of the stone.

As rarer varieties of oxalate of lime calculi are mentioned 'hempseed' calculi, small smooth bodies found in considerable numbers in the kidney, and the crystalline calculi of oxalate of lime, which are more or less white.

Xanthic and cystic oxide.

The xanthic oxide and the cystic oxide calculi are extremely rare; of the former, indeed, only four specimens were known to Mr. Poland. The cystic oxide calculus is not quite so rare. It is found in the kidney, is often multiple, and there seems some hereditary predisposition to its formation. It is distinguished by its wax-like lustre on fracture, by its containing a good deal of sulphur, and by its changing colour with age from a pale yellow to brown, grey, or green.

Phosphate of lime.

Phosphate of lime calculi are chiefly found deposited around a nucleus of some other substance, which may be a lithic acid or oxalate of lime calculus, or may be a foreign body. It is usually of vesical origin, and forms a confused mass, not laminated, but 'resembling mortar, or a granular semi-crystalline powder, enveloped in a tenacious mucus.' These are the 'bone-earth' calculi; but there are others of renal origin, consisting of neutral phosphate of lime, which are 'pale brown, with a smooth polished surface regularly laminated.'



FIG. 374. Phosphate of lime calculus, formed round a nucleus of lithic acid, showing the laminated variety of the phosphatic calculus. — After one of Mr. Poland's plates.

Triple phosphate.

The triple phosphate does not very commonly form a calculus by itself. There are only three specimens in the Museum of the Royal College of Surgeons, and one or two at Guy's Hospital, one of which is figured by Mr. Poland, a remarkable specimen, in which the triple phosphate has been deposited round a piece of tobacco-pipe.

But the majority of phosphatic calculi are of the mixed kind, and these

Fusible calculus.

mixed phosphatic calculi have the remarkable property of melting in the blowpipe-flame, from which circumstance the concretion has received the name of the 'fusible calculus.'

Alternating calculi.

Many calculi are of the 'alternating' variety, in fact, few are absolutely pure; but in those properly called alternating, the condition of the urine has varied during the period of growth of the stone, so that the calculus is composed of definite concentric layers of different deposits alternating with each other. In a very great majority of cases the external layers are formed of the phosphates; and phosphatic calculi are very seldom succeeded by any other form.

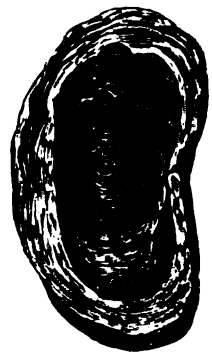


FIG. 375. Alternating calculus. The nucleus is urate of ammonia, mixed with oxalate of lime; this is followed, firstly, by oxalate of lime, secondly by uric acid, and lastly by alternate layers of urate of ammonia and earthy phosphates.—After Poland.

Carbonate of lime.

Carbonate of lime calculus is exceedingly rare in the bladder, but the small concretions which are often found in the ducts of the prostate sometimes consist almost entirely of this substance, and are usually exceedingly numerous.

Pseudo-calculi.

There are various forms of pseudo-calculus, or concretions of organic matter. These are the fibrinous, consisting of condensed fibrine or albumen; the urostealith, consisting of small collections of some resinous or fatty matter; and 'blood calculi,' composed of the remains of blood-clot, with some phosphate of lime. But their occurrence is so very exceptional that they are of little practical importance.

Tests for calculi.

The following table was drawn up by Dr. Bence Jones as containing the easiest and most practical directions for the chemical examination of urinary calculi:—

A. Destroyed by heat; combustible; leaving only a small residue.

1. Become red on the addition of nitric acid, and form a murexide.

a. Soluble in carbonate of potash, evolving no ammonia; soluble in caustic ammonia or potash; on the addition of an excess of acid crystallises in angular crystals, not soluble in water. — Uric acid.

b. Soluble in carbonate of potash, evolving ammonia; soluble in water when boiled; solution in water with a few drops of ammonia, when evaporated, crystallises in needles. — Urate of ammonia.

2. Do not become red on the addition of nitric acid.

a. Soluble in ammonia, not crystallising when evaporated; insoluble in carbonate of potash; dissolves without effervescing in nitric acid, leaving a lemon-coloured residue; soluble in strong sulphuric acid, not precipitated by dilution. — Uric or Xanthic oxide.

b. Soluble in ammonia, crystallising in six-sided plates when evaporated; soluble in strong caustic potash; the solution when boiled for a few moments, on the addition of a drop of dilute acetate of lead, gives sulphuret of lead. — Cystic oxide or Cystine.

c. With difficulty soluble in ammonia, not crystallising; with nitric acid becomes bright yellow; solution in caustic potash precipitable by acetic acid in an amorphous form; emits an odour of burnt feathers on ignition. — Fibrinous.

B. Not destroyed by heat; non-combustible; leaving a considerable residue.

1. Soluble with hydrochloric acid; effervesces before heating; soluble in mineral acids with effervescence; solution in acid, when neutralised, gives a precipitate with carbonated alkalies and oxalate of ammonia; soluble in dilute acetic acid with effervescence.	Carbonate of Lime.
2. Soluble with hydrochloric acid; effervesces after heating; soluble in mineral acids without effervescence; solution in acid when neutralised gives a white precipitate with carbonated alkalies and oxalate of ammonia; insoluble in acetic acid; decomposed by strong sulphuric acid, yielding carbonic acid and carbonic oxide; and when boiled with carbonate of soda, oxalate of soda is found in the solution and precipitated by chloride of calcium.	Oxalate of Lime.
3. Soluble with hydrochloric acid; do not effervesce either before or after heating.	
a. Solution in acid with excess of ammonia gives a white crystalline precipitate; with half its bulk of phosphate of lime (bone-earth) is very fusible before the blow-pipe, and gives off an ammoniacal odour; dissolves in acetic acid without effervescence.	Phosphate of Ammonia and Magnesia.
b. Solution in acid with excess of ammonia gives an amorphous precipitate; with twice its bulk of phosphate of ammonia and magnesia is very fusible before the blow-pipe.	Phosphate of Lime.
c. Solution in acid with excess of ammonia gives a white, partly crystalline, partly amorphous precipitate; without addition easily fusible before the blow-pipe.	Mixed Phosphates.
4. Not acted upon by acids or alkalies; fused with twice its bulk of carbonate of soda forms glass.	Silica.

Calculus in the bladder.

Calculus in the bladder is a complaint which affects all ages and both sexes, but by no means equally. Males are far more liable to be affected than females at all periods of life. This seems due chiefly to the differences in the urethra of the two sexes; for although at a late period of life we could suppose that differences in habits might account for it, yet no such cause can be imagined in infancy, where, however, the exemption of females is quite as striking. And renal calculus, which is the first stage of most cases of vesical calculus, is common enough in the female. The cause of stone is at present unknown. It is far more common in some parts of England than in others, and far more common in some foreign countries than in any part of England;[1] but the reason for the difference is not apparent. If there is any determining cause in either the air, water, diet, or habits of the natives of the affected districts it has not as yet been satisfactorily pointed out. Sedentary habits, indulgence in acid intoxicating drinks, and all other causes which favour the deposit of uric acid or oxalate of lime in the urine may, of course, lead to their deposit in such quantity as to form a stone. Phosphatic stones also form in the kidney under any conditions which increase the elimination of phosphates, and in the bladder from any inflammatory condition, especially when a nucleus is present on which the phosphates may be deposited; but why stone should form in little children who seem to have no reason for any such formation, why it should be so comparatively common in the children of the poor and almost unknown in those who are better fed and tended, and why it should prevail among children in one district while it is hardly ever seen amongst those similarly circumstanced and fed in another part of the country, are questions to which no answer has as yet been given which has commanded universal assent, or which has assumed any practical importance.

[1] So frequent is it in the North-Western Provinces of India, that I have been assured by a surgeon stationed there that he has operated eight times in the same day.

Symptoms of stone.

The symptoms of stone in the bladder are very much the same whatever the composition of the stone may be, though the rougher and more angular the stone the more pronounced will be the symptoms. They are pain in making water, referred especially to the end of the penis, and causing children to be always pulling the prepuce, so as to produce considerable elongation of it. There is usually pain on making any active exertion, such as running or jumping, or jolting in a carriage, though this is not always the case; and pain is often absent in cases of very large stones. Blood in the water is, I believe, a symptom always present at some period or other of every case of stone, though it may, of course, be absent at the time when the case is under examination. There is also a good deal of straining at stool, leading to prolapsus of the rectum in children. Many of these symptoms, however, may be produced by mere irritation of the bladder, and the evidence of the sound is necessary before we can pronounce definitely on the presence of stone. And

Ambiguities in sounding for stone.

even this is not always conclusive. There may be a stone, but from some accidental implication in the walls of the bladder, or from its being contained in a cyst (as in Fig. 385), the sound may fail to strike it.[1] The latter is a very rare complication, but the former is common enough. We constantly see patients who have been sounded, and the surgeon has felt the stone; but on proceeding to operate he cannot feel it. Believing that either the stone has been passed by the urethra, or that he has made a mistake, he puts off the operation, and the next time or even after several such trials (I have known as many as five), the stone has been felt and removed. When therefore the symptoms are well-marked, the surgeon should not too confidently pronounce that there is no stone merely because he cannot feel it. Again there have been cases (and I confess it has occurred to myself, even when assisted by very able colleagues) in which the sensation communicated to the sound by something lying outside the bladder has so exactly resembled that of a stone that the bladder has been cut into and no stone found. This mortifying error is caused by the sound striking some point of bone, I believe generally the spine of the ischium, others say the sacrovertebral angle. Bearing this in mind, it is unsafe, I think, to operate for stone unless as well as the sensation the ring of the stone has been heard, or the stone has been felt (as it sometimes may) with the finger in the rectum. The ring or sound communicated to the instrument by striking a stone is of course decisive. It varies in loudness. When a large hard stone (as of uric acid) is fairly struck with the point of the sound it rings so loudly as to be audible at a good distance; when the calculus is soft and phosphatic, or the sound cannot be moved freely in the bladder, the ring will not be so distinct. A few words may be useful about

Forms of the sound.

sounds. The instrument in common use is a solid polished steel bougie, the shape of a common catheter, made in one piece with a smooth flat handle. It has the disadvantage that in consequence of its comparatively large curve, the point is directed so far upwards that it may ride over the stone and fail to strike it; especially if there be any enlargement of the prostate behind which the stone lies in a kind of pouch. Then again it is often desirable, if the stone has not been hit at once, to vary its position by emptying the bladder, or on the other hand to distend the bladder with water, and so disengage its walls from the stone. All these desiderata are accomplished by the beaked catheter-sound. This is a catheter with a small bore, and an enlarged or 'lobbed'

[1] Cases also have been recorded where the stone has been so covered over by soft semi-solid matter from the bladder that it has not been detected by the sound. See Harrison, 'Lectures on Disorders of the Urinary Organs,' p. 157.

extremity. It has the length and the curve of a lithotrite, i.e. it is straight till within about one and a half inches of its end, where it is turned up, so as to form a 'beak.' There is a stopcock near its handle, and the handle itself is a sort of flat shield on which the finger and thumb can easily rest, and can accurately appreciate sensations from any object which the beak may touch. The smallness of its shaft as compared with its end renders it much more movable in the urethra and neck of the bladder than the common sound is. If introduced with the stopcock closed, it acts as a common sound, but its small end can be more easily applied to every part of the bladder, or can be reversed so as to feel behind the prostate. By opening the stopcock it is converted into a catheter, and as the bladder is emptied the stone often drops down and the sound touches it, and then if the surgeon thinks right an injecting syringe can be applied, and the bladder filled to distension and carefully investigated.

Methods of appreciating the size and number of stones.

Calculi are often numerous, and it is very desirable to ascertain if possible with some approach to precision what the size of the stone is, and whether there is only one or several in the bladder. An experienced surgeon will usually form a tolerably correct idea of the size of a stone from striking it, and examination with the sound will sometimes enable him also to guess at the presence of more than one stone, but the only sure way to ascertain either of these particulars is to sound with the lithotrite. By catching the stone in one or two positions an accurate idea of its size is obtained, and often the surgeon having one stone in the grasp of the forceps can distinctly ascertain the presence of another.

The endoscope.

The endoscope, a tube illuminated by a lamp at its extremity and closed by a piece of glass, was introduced some years since as a means of looking down the urethra, and seeing the face of a stricture or the wall of the bladder, and some surgeons have professed thus to be able to determine the presence, nature, size, and number of foreign substances in the bladder; but the difficulty of the investigation is so great, and the portion of tissue seen at one time is so minute, that I believe I am not wrong in saying that the endoscope is now generally disused.

Terminations of stone.

If the symptoms of stone be allowed to persist unrelieved the patient usually dies from general disorganisation of the urinary organs, the result of obstruction and inflammation; sometimes from pyæmia, brought on by phlebitis of the veins around the prostate; sometimes by ulceration and perforation of the bladder.[1] In any case the mode of death is a very painful one, and it is desirable to attempt the removal of the stone even in cases where the surgeon feels that there is but little chance of success.

Operations for stone.

Two methods only are at present known for removing calculi. Chemical solvents have been sought for centuries; sometimes it has been believed that the discovery has at last been made; the electric current also, it has been imagined, might be used for their disintegration; but hitherto all such plans have failed, and though it seems most probable that ultimately stones will be dissolved in the bladder, we have at present to deal with lithotomy and lithotrity.

Comparison of lithotomy and lithotrity.

The preference of one method to the other is regulated on some such general rules as these:—

1. In male children lithotomy is very successful; lithotrity, on the con-

[1] Stones have been known to travel by ulceration through the bladder into the scrotum or perinæum, from which they have been extracted by an incision.

trary, is not very appropriate, in consequence of the small size of the urethra, and the irritability of the bladder. Hence most surgeons reject lithotrity absolutely in childhood, and if it is ever to be practised it should be only when the stone is judged to be so small that it may easily be pulverised at one sitting. By childhood I mean any age up to fifteen.

2. Lithotrity is not to be recommended in cases of tight stricture. It is true that if the symptoms are not urgent the stricture may first be cured; still stricture is often associated with an irritable condition of the urethra and bladder, highly unfavourable for the success of the crushing process. In slighter cases of stricture there is not the same objection. Enlargement of the prostate, especially if only moderate, does not contra-indicate lithotrity; though it may be an element in the judgment which the surgeon will form in a dubious case.

3. Lithotrity has no chance of success in patients suffering from extensive renal disease. It is true that such patients usually die after lithotomy, but if it is judged necessary to perform any operation at all, lithotomy is on the whole the best.

4. In cases of very large or very numerous stones the lithotrite may perhaps not have room to work. Such cases must be dealt with by lithotomy, and even when the stone does not fill the bladder, but still is so large that it would require numerous sittings, and the patient is at all irritable, it is doubtful which is best. The composition and hardness of the stone were questions of much importance in the old method of lithotrity by repeated sittings, since a large concretion can be rapidly broken up if it consists chiefly of soft phosphates, and the débris will pass with but little pain, whereas a uric acid or oxalate of lime stone is broken into sharp fragments, many of them of considerable size, very apt to lodge in the urethra or to inflame the coats of the bladder.[1]

5. In the female, as a rule, lithotrity is easy if the stone be small, but in larger concretions, and in the case of female children, lithotomy may become necessary.

Lateral lithotomy.

The operations of lithotomy are numerous. The one in almost universal use in England is the lateral operation, which accordingly I shall describe.

The perinæum is to be shaved if necessary. The staff is then to be passed, and the patient is to be drawn to the edge of the table with the buttocks slightly projecting over the edge, the feet and hands secured together, the hand grasping the dorsum of the foot. They are secured either with the garters or shackles.[2] The knees are held apart, the patient's body kept quite

[1] The result of Sir H. Thompson's ample experience (before the introduction of Bigelow's method of lithotrity at one sitting) led him to doubt whether in the harder kinds of stone lithotomy is not the safer operation, when the size of the stone exceeds about that of an almond in its shell, i.e. its longest diameter ought 'rarely to exceed one inch or an inch and a quarter.'—'Med.-Chir. Trans.' vol. lxi. Since this time, however, the question has assumed quite another aspect; and it seems that these large stones may be more safely dealt with by lithotrity with evacuation than by lithotomy.

[2] The 'lithotomy position' is used in many operations on the genital organs both of the male and female. Three methods are in use for maintaining the patient in this attitude, i.e. in the sitting posture with the feet grasped in the hands, and the knees widely separated. 1. The lithotomy-garters, two bandages of some firm webbing about eight yards long and terminating in a loop. The whole bandage is first passed through the loop, and into the loop so formed the forearm is passed, and it is drawn tight. Then the hand is made to grasp the foot and the bandage is wound around them in successive turns of figure of 8, and the end firmly pinned. 2. The 'shackles' consist of a leather foot-piece securely laced over the ankle, and a leather band around the wrist. To the foot-piece is attached a ring and to the

perpendicular to the table, the staff held vertical by a steady assistant, with its point well in the bladder, and if possible resting on the stone. Then an incision is made from the left side of the central point of the raphé to the point midway between the anus and the tuber ischii and drawn backwards into the ischio-rectal region as far as is judged necessary. This incision should divide the skin and superficial parts. The surgeon then puts his left forefinger into the upper angle of the wound, deepens the incision till he can distinctly feel the groove of the staff, puts the point of his knife into the groove, and then pushes the knife on till it reaches the bladder. Having reached the bladder he withdraws the knife, enlarging the wound a little as he does so, by lateralising the edge of the knife and pressing it a little on the parts. Then he pushes his left forefinger along the concavity of the staff till it reaches the bladder, which it will do if he have made the wound free

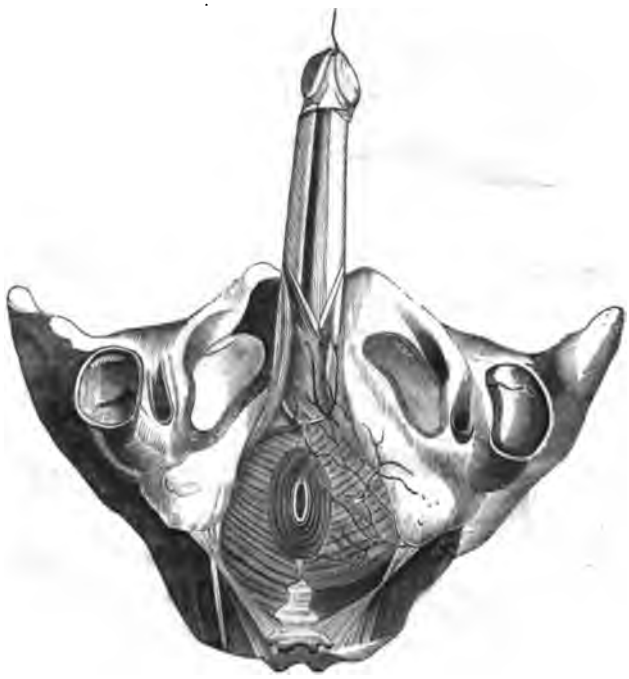


FIG. 376. A dissection of the perinæum, showing the position of the bulb of the urethra and the floor of the ischio-rectal fossa. (After Pirrie.) The incision in lateral lithotomy is commenced just over the bulb, but the operator makes that part of the incision superficial, so that the bulb and its artery escape. He divides the floor of the ischio-rectal fossa (the anterior fibres of the Levator ani), and reaches the membranous part of the urethra, as shown in the next figure.

enough. Having placed his forefinger on the stone he withdraws the staff, and passes the forceps along the upper side of his finger. When the forceps

wrist-piece a hook. The pieces are put on while the patient is taking the anæsthetic, and when he is insensible he is put in the proper position, and the hook passed into the ring. 3. Mr. Clover invented a very handy crutch—a piece of iron about a foot long, ending at either side in a bend to which a strap is attached. The thighs being flexed on the abdomen and abducted, are supported by the bent ends, and prevented from moving by the straps, and thus are kept bent and open. Of the three plans the shackles are much superior to the lithotomy garters, being less troublesome to apply and more secure from slipping. Mr. Clover's crutch is very easily and quickly applied, and answers its purpose very well; but does not, I think, keep the patient quite so steady. When none of these apparatus is at hand common bandages will do very well, applied like the lithotomy garters.

have reached the bladder he opens the blades, and then a gush of urine occurs. The stone is often thus carried into the grasp of the forceps, otherwise it must be felt for, the forceps applied to it (taking care that the coats of the bladder are not caught also), and the stone then withdrawn in the axis of the pelvis. If it is not very large there is no difficulty about this; but if it is, gradual dilatation of the wound with the stone and forceps by a sort of corkscrew motion is necessary. After the stone has been removed the bladder should always be carefully searched to see whether there is another.

A few words about each step of this operation are necessary.

In the first place it is essential that the stone should be felt with the staff itself upon which the surgeon is to make his incision. It is not enough that a calculus has been felt on the previous occasion, nor even with another instrument while the patient is on the table. In order to be certain that the



FIG. 377. The second step of the operation for stone. The knife entering the groove of the staff in the membranous portion of the urethra.—After Pirrie.

stone is really present and the staff properly lodged in the bladder, the stone should be struck with the staff itself.

As to the shape of the staff there are different fashions. Most surgeons use a staff of the same shape as a catheter. At Guy's Hospital, the 'straight' staff (which, however is not accurately straight), is preferred, the supposed advantage being that there is less risk of the knife slipping out of the groove. But as this ought never to happen in careful hands, and the straight staff is more difficult to find in the perinæum, I fail to see any advantage which it has; nor can I see the necessity of making the groove on the side, instead of in the centre of the staff. The rectangular staff was for some time in favour with some good surgeons, but, I believe, is now generally disused. It has the great drawback of being very awkward to pass and very liable therefore to make a false passage, a drawback very imperfectly counterbalanced by its one

advantage, that its angle is easily found in the perinæum.[1] As for the position of the staff in the bladder, some surgeons direct that it should be inclined to the left side, in order to present its groove more readily to the operator. This seems to me a matter of indifference; the main point is that it shall be steady and not slip out of the bladder, and this, I think, is best secured if the assistant holds it vertically, hooking it against the pubes.

The main dangers in the operation are as follows:—

Dangers of the operation.

There may be unavoidable hæmorrhage from some unusual distribution of the arteries. This proceeds generally from the internal pudic furnishing an accessory internal pudic, instead of bifurcating in its usual position under cover of the ramus of the ischium, or from an abnormal course of the artery of the bulb. Again, very free hæmorrhage may take place in old persons from the veins about the prostate and neck of the bladder. The only thing that can be done is to tie any divided artery if possible, or if the vessel cannot be secured to hasten to complete the operation, and then plug the wound with 'the petticoat plug,' i.e. a large catheter or tube passed through a piece of stout cloth into which a quantity of lint is pressed sufficient to fill and make considerable pressure on the sides of the wound. Avoidable hæmorrhage proceeds generally from the artery of the bulb if the wound be deepened too much at its front part, for it must be recollected that the incision commences over the position of the artery. But in children this artery is so small that its division is of no consequence; in fact, I believe that it is almost always divided. It is said that the internal pudic may be cut if the incision is extended too far outwards; but this seems impossible if the artery occupies its natural situation, and probably in the cases in which this has happened the artery has been abnormal. The great danger in lithotomy is, that the urethra should be broken across and pushed before the finger into the pelvis; or that the knife should leave the groove of the staff, and so the incision be made not into the bladder, but between it and the rectum. In either case the surgeon does not reach the bladder, and I have seen cases in which an inexperienced lithotomist under these circumstances, believing that he had reached the bladder, withdrew the staff, and in one case was obliged to give up the operation altogether; in another, completed it by the help of a senior colleague, but with great risk and difficulty. This is avoided by making the incision into the staff free enough to admit the finger, and never letting the point of the knife quit the groove as it is being pushed into the bladder, nor taking the staff out till the finger is in actual contact with the stone. One of the great difficulties in lithotomy in little children is to make the incision large enough to admit the finger without wounding the rectum or other parts around. Much has been said as to the danger of incising the whole of the prostate and thus laying open the cellular tissue beneath the recto-vesical fascia, whereby it is supposed the urine from the bladder is admitted into the meshes of the cellular tissue, infiltrating it and producing diffuse cellulitis. This doctrine rests on high authority, yet it has been much questioned. In children the whole prostate must necessarily be divided, for the gland is too small to allow an entrance to the bladder otherwise; yet children never suffer from the diffuse suppuration which is supposed to be the result of such division. And, as Sir

[1] If the rectangular staff is ever to be used, the apparatus invented by Dr. Buchanan should be employed. In this apparatus after the staff is lodged in the bladder a director is fixed on to it which terminates in a point. This point pierces the perinæum and is received into a hole in the angle of the staff. The surgeon has now nothing to do but follow the groove of the director straight into the bladder.

H. Thompson has justly observed, the effect of the passage of an irritating fluid like urine over the fibres of the cellular membrane would be to close the interstices between the fibres, not to open them.[1] It is, no doubt, prudent not to carry the deep incision further than is absolutely necessary; yet it appears to me safer in the case of large stones to make a sufficient incision than to lacerate the prostate and the neighbouring tissues, as is often done in such cases. For small stones a very moderate incision, dilated by the forefinger, suffices; for larger calculi, a freer cut is required, or if the stone sticks in the incision a blunt-pointed straight bistoury may be passed along it, and the constricting parts nicked here and there.

When the finger is placed on the stone, the latter may be so small and smooth as not readily to be grasped by the forceps. The scoop is then very useful. This is an instrument exactly resembling a small spoon with a very long handle. It is slipped under the stone, which is held in it by the forefinger.

When the operation is over some surgeons always pass in a straight tube which is tied in: but this is not necessary, except in order to repress hæmorrhage, as stated above.

The rectum is to be unloaded before the operation, and will then almost certainly escape injury if the surgeon is moderately dexterous. A gentle purge should be given on the second night before operation, and the lower bowel should be completely emptied by an injection exhibited about eight hours before the operation. This will both unload the bowel and prevent the patient being disturbed for a day or two afterwards.[2] If it should happen that the rectum is injured the wound in it should be united if possible, and may very probably heal, otherwise the resulting fistula is very intractable (see below).

The after treatment is very simple. The urine runs into some tow or carded oakum placed beneath the patient and frequently changed; and if he is irritable, he is to be kept tolerably under the influence of opium.

Causes of death after lithotomy.

The main causes of death after lithotomy are pyæmia, hæmorrhage, peritonitis, diffuse inflammation, and sinking from renal disease. The operation, particularly when protracted, as in the case of very large stone, may prove fatal by the immediate shock.

The danger of the operation depends mainly on three things: the state of the general health, and especially of the urinary organs, the age of the patient, and the size of the stone. In persons of almost any age, who are of sound constitution, and in whom the kidneys are healthy and the bladder not extremely degenerated, lithotomy is a very successful operation. In children death is very rare; the small proportion (about 5 per cent. on an average) who die being chiefly weakly infants exhausted by previous suffering or labouring under visceral disease. But when the stone is of large size and there are evidences of very acute inflammation, that inflammation has usually extended to the ureters and kidneys, and any slight injury would probably prove fatal, still more, the formidable operation by which alone a large stone can be removed. The inference is, that no delay is admissible in cases of stone. When the symptoms become more accurately known to the public, and the necessity

[1] The student must recollect that the 'cellular' tissue, though capable of being distended into cells or spaces, yet in the living body contains no such spaces—all its fibres are in close contact, and the old term 'cellular membrane' is far more expressive of its real condition.

[2] In children the rectum often protrudes during the operation. This gets it more out of the way, and the advice usually given to repress the prolapsus is undoubtedly wrong.

of seeking competent advice at an early period is generally recognised, stones will be disposed of when of small size by lithotrity, lithotomy in the adult will become an even rarer operation than at present, and stone will be only rarely a cause of death.

Recto-vesical, and recto-urethral fistula.

After the operation for stone, a fistulous communication may be left between either the bladder or urethra and the rectum. The latter is far more common, for the wound in the neck of the bladder generally heals, and the patient regains the power of retaining his urine; but it passes into the rectum and becomes a source of constant annoyance and irritation. Recto-urethral fistula occurs also (as mentioned above) from prostatic abscess, though rarely; and I have known it follow on too free incisions for anal fistula. It has been known also as a consequence of ulceration of the urethra behind a stricture, or as a complication of stricture of the rectum. The cure is by no means easy. If the catheter can be passed into the bladder without going into the rectum, the urine should be drawn off in this way every time the patient wants to make water, or he should be instructed always to make water lying on his face; and a few weeks' perseverance in this treatment may be successful—the edges of the fistula being stimulated with the tinct. lyttæ or the galvanic cautery. But unluckily, it is only in rare cases that this can be done. In some cases a cure may be obtained merely by stimulating the edges of the sinus with the galvanic cautery, with or without division or stretching of the sphincter ani.[1] On the failure of such measures a plastic operation is necessary and, of all other plastic proceedings, seems to me one of the most disappointing. It may be performed in one of two ways. The patient (under chloroform or not) is placed in the prone position with his legs separated and hanging over the table. A duckbill speculum in the rectum exposes the fistula, which is to be pared and its edges united, and a catheter passed into the bladder and kept open, so that the urine shall flow out constantly. If this fails the surgeon may lay the parts freely open into the anus, endeavour to separate the urethra from the rectum, and unite the tissues over a catheter passed into the bladder, so as to close the urethra and leave the rectal wound to granulate. I have, however, treated and seen others treat, these fistulæ after lithotomy, and, I confess, with very little success.

Median lithotomy.

The lateral operation appears to me to be the best suited for all ordinary cases. In some instances, however, where the stone seems impacted in the urethra or neck of the bladder (as seen in Fig. 387) the median operation (which often bears the name of Mr. Allarton, in consequence of his having revived it, and recommended its general adoption) may be preferred, and it is also an easy and ready way of removing small stones in childhood.

A grooved staff is passed into the bladder; the left forefinger in the rectum feels the groove just as it disappears in the prostate gland. The surgeon plunges the point of his knife into the groove, at or near this point, holding the edge upwards and taking care not to perforate the rectum. He pushes the knife on a little way so as first to nick the prostate gland, and withdraws it, making at the same time a free division of the raphé of the perinæum, leaving a conical wound, at the bottom of which the groove of the staff is exposed. A director is then passed along the groove of the staff into the bladder, and when the stone has been felt with this director the staff may be withdrawn. A pair of dilating forceps are passed along the director, and the

[1] See Birmingham, 'New York Med. Journ.' Feb. 1876.

wound dilated until the finger passes into the bladder, when the operation is completed in the usual way.

Other methods of perinæal lithotomy.

The aim of the operation is to avoid the danger, or supposed danger, of incising the prostate. Its drawback is the difficulty of removing anything like a large stone through the wound without a most injudicious amount of violence. Other surgeons join with a lateral or median incision of the perinæum incisions into the prostate gland, made by means of a *lithotome*, which is a bistouri caché with one or two blades, made to project at different angles so as to incise both lobes of the prostate horizontally (Boyer); or with a curvilinear incision on each side (Dupuytren); or horizontally on one side and obliquely on the other (Senn); or obliquely upwards and downwards on both sides (Vidal de Cassis). Such operations are known as bilateral lithotomy. Others, again, make the incision in the middle line of the perinæum while incising the prostate with the knife in various directions. But these operations are little if at all practised in this country, experience having shown to the satisfaction of the great majority of surgeons that the lateral operation is, on the whole, the best; as affording more room than any of the others if the stone be large, and being equally safe, if not more so, when it is small. It is true that it has its difficulties and dangers, but they seem, on the whole, less than those attending on the other methods.

Rectal lithotomy.

It remains to speak of two plans which are occasionally resorted to, viz. rectal lithotomy, and the hypogastric or high operation. The recto-vesical operation is now only used in this country as a last resource, when the stone is too large to come through the ordinary incision and the operator cannot break it,[1] and consists merely in extending the incision into the rectum as far as is judged necessary. This may sometimes be the operator's duty; but in a case which I once saw, and which, in other respects, was quite successful, a fistula was left between the urethra and rectum which could not be closed. The old recto-vesical operation (which was, I believe, frequently adopted by Mr. Lloyd of St. Bartholomew's Hospital) was commenced in the rectum. It resembled the median operation to some extent, but the surgeon, instead of plunging his knife into the urethra in front of the prostate, passed it with his left forefinger into the rectum, pierced the wall of the rectum and urethra or neck of the bladder, and then cut outwards in the middle line, through the external sphincter and perinæum.

The hypogastric or high operation.

The hypogastric or high operation is only used in this country when the stone is believed to be too large to be extracted through the perinæum, or when the pelvis is too rickety. The bladder should be filled with water in order to distend it and push away the peritoneum as much as possible. Then the linea alba is to be divided for an inch or more above the pubes, and the dissection carried cautiously down until the point of the staff is felt, when the bladder is to be carefully drawn up into the wound and opened, the stone extracted, and the wound left to itself. The main danger is that of wounding the peritoneum. In one case, at which I assisted, the peritoneum came down so low, and the bladder could be so little distended, that it was only possible to avoid that membrane by incising the parietes in a cruciform instead of merely a vertical direction. The patient, a rickety infant much exhausted by his sufferings, ultimately sank from exhaustion.

Perinæal lithotrity.

In cases where the stone is too large to be extracted, it must be broken down by a kind of lithotrite or forceps before its fragments can be brought out of the wound. Various contrivances have been invented for this purpose.

[1] See a case by me in vol. xxv. of the 'Path. Trans.'

and it is well to have an instrument of the kind at hand when the stone is suspected to be very large; but operations on such complicated cases are rarely successful. Lately Professor Dolbeau of Paris has introduced, as a substitute for lithotomy in general, an operation which he calls 'perinæal lithotrity.' As this operation has not yet obtained a recognised place in surgery, I cannot describe it minutely. It consists in making a small median opening into the membranous part of the urethra, dilating successively the external incision—the urethral opening—the deeper part of the urethra—and the neck of the bladder—seizing and breaking the stone—extracting the pieces and carefully washing out all débris. The operation requires peculiar instruments and various precautions, for which I must refer to Prof. Dolbeau's work, 'La Lithotritie Périnéale,' or a short account by Dr. Ewart in the 'Lancet' for October 17, 1874.

Lithotomy in the female.

Lithotomy in the female is an operation of much less danger than in the male, the parts being so much more superficial, but it is much more liable to be followed by incontinence of urine. It may be performed in many ways. A proceeding something like lateral lithotomy may be effected by passing a staff into the bladder and making an incision running outwards through the upper wall of the vagina. Or the urethra may be incised directly upwards to an extent sufficient to allow of the passage of the finger and forceps into the bladder. It must be remembered that the female urethra is so distensible that in the adult, even without any incision, the finger can, under chloroform, be introduced by dilatation and gradual pressure into the bladder. In fact, when it is difficult otherwise to detect a stone, a foreign body, or a tumour, this plan should be adopted. Vaginal lithotomy may also be practised, the lower wall of the bladder being laid open, and the incision sewn up at once and the case treated as a vesico-vaginal fistula; and this is on the whole the most appropriate operation in the adult, as involving less risk of incontinence than any other: but most stones can be removed from the female bladder without any cutting operation. If they are too large to be extracted whole, they can be broken with the lithotrite and removed in fragments, the urethra having been dilated. Usually, however, the whole stone can be removed by Bigelow's method of lithotrity.

Lithotrity.

Lithotrity is the operation by which the stone is broken to pieces in the bladder, and the pieces either extracted at the time through the urethra or allowed to come away with the urine.



FIG. 378. The common screw lithotrite. The male blade is opened and shut by the lunated catch seen on the handle, and when the stone is firmly caught the screw is driven home. The female blade is usually perforated by a large opening ('fenestrated') in order to avoid the jamming of fragments in the blades. When it is intended to use the lithotrite as a scoop and remove the fragments this blade is not fenestrated.

I will describe first the old method of lithotrity at several sittings, although I believe that it will soon be entirely replaced (as it already is in the practice of the most experienced surgeons in this operation) by Bigelow's method of lithotrity with evacuation. The lithotrite is a pair of forceps, the shape of a catheter, only with much smaller curved end, and curving more abruptly, one blade of the forceps (the male) being received into the lower or female blade moving in a groove by means of a handle, and shutting down by a screw.

The object of lithotrity is to catch the stone between the two blades of the lithotrite, without injuring the walls of the bladder, and then by forcing the male blade through it, to fracture or crush the stone, and by re-

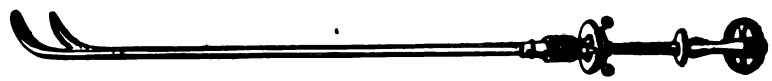


FIG. 379. Civiale's lithotrite. By turning the two little buttons on the handle horizontal, the male blade is detached from the screw, and made movable. When the stone is caught, the buttons are turned vertical and then the screw will act on them.

peating this operation break it down into pieces small enough to pass through the urethra, or to be extracted by aspiration.



FIG. 380. Thompson's lithotrite. The fluted cylindrical handle affords an easy hold for the surgeon. Pressure on the button in the handle disengages the screw. The object of these newer forms of lithotrite is to enable the surgeon to grasp the stone and set the screw in motion, with less manipulation, i.e. less change of position of the hands, than in the common screw lithotrite.

The urethra should be previously dilated, if necessary, until it will easily admit a large instrument, and it is better to ascertain beforehand that the

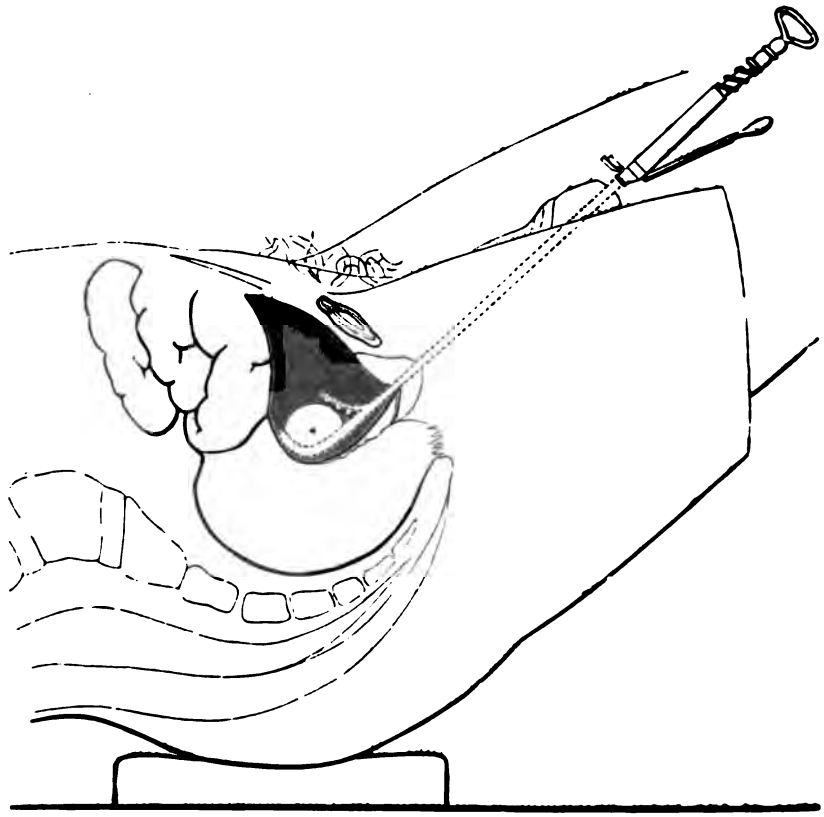


FIG. 381. The English, or Brodie's, method of lithotrity. The lithotrite has been passed to the base of the bladder and the stone allowed to fall into its grasp.—After Sir H. Thompson.

passage of instruments is well borne by the patient. Then, the general health being ascertained to be good, and all other indications being favourable (see

p. 882), the process should be commenced. It was always usual to inject a certain quantity (say 6oz.) of water into the bladder. This is now often omitted as superfluous; but if it is not done the surgeon ought at any rate to ascertain that his patient's bladder is full, i.e. that he has not passed water for three or four hours previously. The lithotrite is to be passed fully into the bladder before it is opened. Then there are two different methods of catching the stone. Both are in use by most eminent and successful operators, and it seems clear to me that they are about equal in value. The most important matter is to acquire dexterity by constant practice in the method selected. The one which is commonly called the English or Sir B. Brodie's method consists in sinking the closed lithotrite to the base of the bladder, when if the instrument be opened to its full extent the stone will

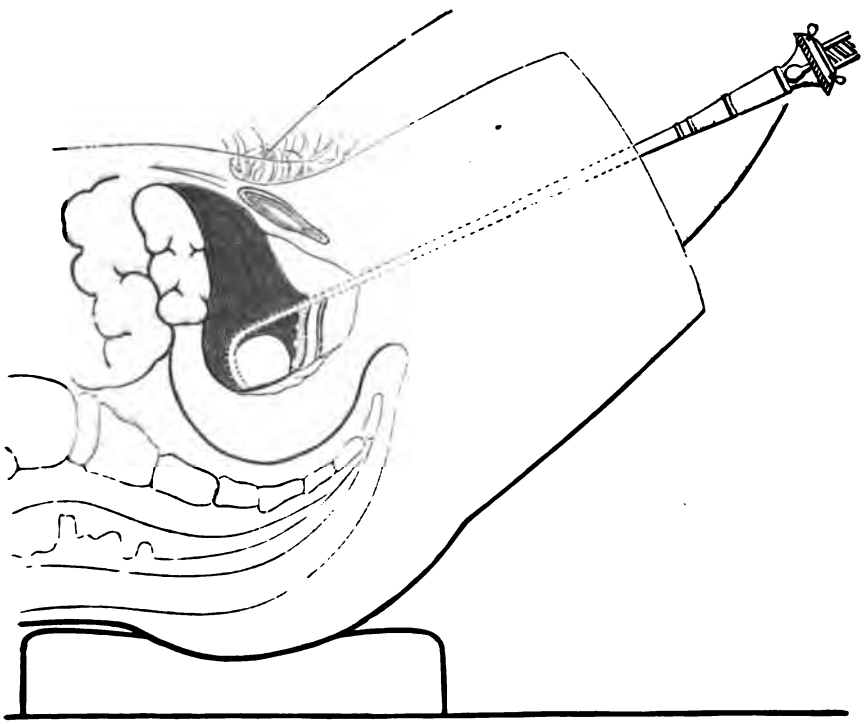


FIG. 882. The French, or Civiale's, method of lithotrity. The lithotrite is reversed to seize a large stone.—After Sir H. Thompson.

usually fall within its blades, especially if the patient's pelvis be moved or slightly shaken. The other method—the French or Civiale's—consists in feeling the stone with the lithotrite, as with a sound, and then gently in clining the instrument away from the stone sufficiently to open the blades, which are then to be applied to the stone. This may be necessary when the stone lies partly or entirely behind the prostate. When the stone is grasped and the male blade securely screwed down on it, the lithotrite should be moved a little way so as to make sure that it is free of the wall of the bladder, and then the instrument is closed and the stone crushed. When this has been once done, there is generally no difficulty in picking up and crushing other fragments; but it is not prudent at first to proceed too far.

As a general rule about three actions of the lithotrite will be enough at

first. If the patient bears the operation well, more may be done at subsequent sittings. The administration of chloroform or ether is not, ordinarily, necessary, since the operation, if dexterously done, does not give much pain; but if the patient be nervous there is no objection to it. Some surgeons, and especially Sir W. Fergusson, have recommended the withdrawal of such fragments as can be extracted by means of a scoop; but the general opinion is that if the operation is not to be finished at a single sitting, it is on the

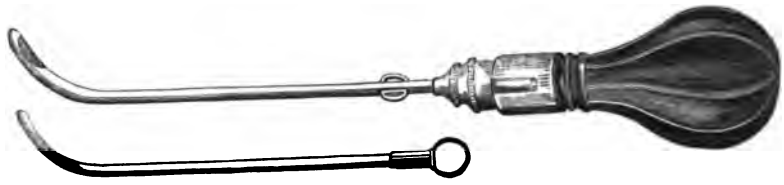


FIG. 883. Clover's syringe. The indiarubber ball is filled with water. This is injected into the bladder with the instrument as nearly vertical as may be. Then the ball is allowed to expand, drawing the water and fragments of stone up the eye of the instrument. The fragments fall into the glass receptacle by their own weight, and the process can be repeated several times without any risk. If a fragment too large to pass should fall into the eye of the catheter it must be dislodged before withdrawing the instrument. This is accomplished by passing the stem figured below the catheter.

whole better to allow the fragments to pass of themselves, and to avoid all manipulation which is not absolutely necessary. If the bladder is paralysed or if the surgeon from any cause is anxious to hasten the process, the ingenious apparatus devised by Mr. Clover may be employed to remove the fragments from the bladder. It is figured and its action explained immediately above. The sittings may be repeated at intervals of five or six days if there have been no bad symptoms, or even more frequently.[1]



FIG. 884. A fasciculated bladder, having in the interstices of its muscular coat a number of lithic acid calculi, some of which appear to be partly adherent to the coats of the bladder. From a preparation presented by Sir B. Brodie to the Museum of St. George's Hospital, Ser. xii. No. 30.



FIG. 885. Impaction of fragments of calculus in a pouch of the bladder after lithotrity.—St. George's Hospital Museum, Ser. xii. No. 34.

In cases which do well the patient passes the stone in small fragments with little or no inconvenience, until ultimately the nucleus comes away and his symptoms are relieved; but there is often a good deal of trouble in deciding whether there is a small fragment left in the bladder or no, and it is obvious that there may be cases in which the detection of a single fragment may, be well-nigh impossible. Thus the bladder may be fasciculated as in Fig. 884, and it will be easy for a fragment to slip into one

[1] It would, however, be better to use Bigelow's method in all cases of this description in which the patient can bear protracted anæsthesia.

of the pouches between its muscular fibres, where it will be very difficult to strike it. For the purpose of disengaging such fragments, the bladder is to be filled with a large quantity of water before searching in a doubtful case.

Or it may even happen that there is a definite pouch in the bladder, as in Fig. 385, when the surgeon will naturally believe that he has removed all the fragments, and the patient will suffer from no symptoms except when the stone happens to escape from the pouch. Such cases are very difficult to treat, but they are rare; and in ordinary instances there is no difficulty either in determining the presence of a fragment, or in detecting and crushing it.



FIG. 386. Hypertrophy of the prostate gland, the middle lobe of which projects into the cavity of the bladder. The bladder is thickened and fasciculated, and its mucous membrane was in a state of chronic inflammation. In the bladder was a stone, for which the patient, an elderly person, underwent the operation of lithotrity. The first operation passed off well, but at the second, which was seven days after the first, he had a severe rigor, from which he never rallied, and died ten days afterwards. Some fragments of calculus, seen at the bottom of the figure, were found in the bladder. The bladder had not been in the least injured by the operation; the kidneys were inflamed, large, and soft in texture, the pelvis of the right being covered with lymph, and containing a quantity of puriform fluid. On the external surface of this kidney were some small cysts containing pus.—St. George's Hospital Museum, Ser. xii. No. 35.

Sir H. Thompson says:—'As long as any remain, there will almost invariably be pain in passing water, especially at the close of the act, while the urine may be cloudy and often tinged with blood, and quick movements of the body give pain. As long as these symptoms persist we may be assured some portions still remain behind, and these must be found.'

Complications.

The bad symptoms which sometimes follow lithotrity are as follows:—

1. Inflammation of the bladder may be produced by unskilful manipulation, or even when all possible skill has been exercised the cystitis previously existing may be aggravated either by the necessary operation, or by the sharp edges of fragments. This may run the usual course of cystitis, and subside, leaving the patient in a condition to continue the treatment, or perhaps in the surgeon's judgment rendering a resort to lithotomy preferable.[1]

2. Enlargement of the prostate gland may cause much difficulty in passing the fragments, which will be detained in the bladder, irritating it and propagating inflammation to the kidneys. In rarer cases the same effect is produced by partial paralysis, or by atony, of the bladder. Clover's syringe, or some other form of aspirator, is peculiarly useful in all these cases.

3. The plexus of veins which surround the neck of the bladder may be irritated and inflamed, and this may prove the starting point of general pyæmia. I have seen pyæmia prove fatal in a chronic form, even in a case

[1] In many cases, however, when the irritation is considerable but the patient otherwise in a good state, it is best to crush the larger and sharper fragments at once, and this will relieve the cystitis.

where the stone had been very small and had been entirely crushed and removed. A small ulcerated surface existed in the bladder, which had doubtless been produced by the stone itself, as the patient had complained of acute pain for a long time before the operation, especially after making water. But I have also seen pyæmia come on in the acutest form and prove fatal in a week.

4. The impaction of fragments is one of the most dreaded sequelæ of lithotrity. It is the opinion of some of the best authors that this impaction hardly ever happens unless the urethra has been lacerated, i.e. that a fragment which is small enough to pass into the urethra will be passed on by the walls of the canal if they remain perfect, however sharp its edges or angles may be. This does not of course apply to the meatus, which is much smaller than the rest of the urethra. It often happens that the nucleus or last fragment of the calculus lodges there, but this merely requires that the meatus should be incised and the fragment removed. The fact that impaction is far more frequent when the urethra has been lacerated constitutes a grave objection to the proposal to remove the débris in the lithotrite-scoop immediately after crushing.[1]

When a fragment is impacted retention of urine and pain will be produced. Retention, however, occurs sometimes without any impaction. Sometimes the fragment comes so far forwards as to be felt from the surface, more commonly it is buried in the perinæum. In the latter case, if the symptoms are not very urgent, the warm bath and opium will sometimes enable the patient to make water and bring the fragment forwards, when possibly it will pass without further trouble. If the fragment is lodged near the neck of the bladder, it may be gently pressed back with the lithotrite and crushed at once. If further forward than the scrotum it may be extracted by means of the urethra-forceps—an operation requiring great care, delicacy, and slowness of manipulation. In a very few cases it is necessary to cut down in the middle line of the perinæum, when the surgeon will naturally consider whether he ought not to perform lithotomy at once, and in still rarer cases he may have to cut into the urethra in the penis.

5. The other complications are of minor importance. Some amount of retention not unusually follows a first sitting; orchitis, or epididymitis, is not uncommon from irritation of the urethra after the passage of fragments. Rigors and 'urethral fever' occur after this, as after all other operations on the urethra, but all these complications are to be treated on general principles.

It will perhaps be best to close this section with the following 'practical hints' from Sir H. Thompson's work on Lithotrity.

1. It is occasionally desirable that the urethra be accustomed to instruments before operating, so that the lithotrite, which it is necessary to employ, can be passed without causing much uneasiness, or any bleeding.

[1] Sir B. Brodie writes on this subject as follows:—'There are, however, some very grave objections to this mode of proceeding. The withdrawing of the forceps, if much loaded with calculous matter, stretches the urethra beyond its natural diameter, and, in so doing, not only gives the patient much pain at the time, but renders him liable to rigors afterwards; secondly, in four instances in which I had adopted this practice the urethra was torn, and an infiltration of urine into the surrounding tissues, followed by urinary abscess, was the consequence. Two of these patients in whom the mischief produced was deep in the perinæum, died, notwithstanding the abscesses having been freely opened as soon as they were detected.'—'Med.-Chir. Trans.' vol. xxxviii. p. 175. Sir H. Thompson speaks also to the same effect, and indeed, since the introduction of the new method of lithotrity with evacuation, this plan of removing the fragments has been quite superseded.

2. Always operate, whenever this is possible, without previously disturbing the bladder by injecting or sounding.

3. Having determined the position of the patient according to the necessities of the case, slowly introduce the lithotrite, and take care that the blades reach or pass beyond the centre of the bladder before the male blade is withdrawn.

4. Execute every movement deliberately; open and close, incline, or rotate, slowly, without any jerk whatever; and all without bringing the blades into contact, as far as it is possible, with the walls of the bladder.

5. Maintain the long axis of the instrument in the median line of the body and the blades at or near the centre of the bladder, this being the area for operating mostly to be chosen. In screwing home the male blade to crush, it is especially necessary to keep the instrument steady, to avoid much vibration of it or much lateral movement of the blades from its axis at each turn; a small deviation at the handle produces a large one at the blades.

6. The position of a large stone is often very near the neck of the bladder. But the position of the stone varies much in different cases. When it is difficult to find or seize it, the reason usually is that the stone lies close to the neck of the bladder, so that the male blade, when drawn out, impinges upon the stone, instead of including it within the grasp of the instrument. It is necessary then to insinuate carefully, by a lateral movement, the male blade between the stone and the neck of the bladder.

7. When the stone is caught, especially if in the fenestrated lithotrite, rotate it a fourth of a turn on its axis before screwing up firmly or crushing, to make certain that nothing is included besides the stone.

8. Having broken a stone or a large fragment, the operator may pick up and crush piece after piece consecutively, without further searching, if he is only careful to work the lithotrite exactly at the same spot—the patient of course not shifting his position—since fragments fall immediately beneath the blades of the instrument, and rest there.

9. Never withdraw a lithotrite *loaded* with calculous débris; a moderate quantity will come away between the plain blades; but if an impediment is felt at the neck of the bladder on withdrawing, return to the centre of the cavity and unload them. This can always be done with a properly constructed lithotrite.

10. No sitting should exceed five minutes in duration, except under very peculiar circumstances. The large majority of sittings should occupy only three minutes, some less. The mere sojourn of a lithotrite, without any movement, for three minutes in the bladder, causes uneasiness, and often subsequent irritability, which may be considerable if the time is prolonged.

11. If the patient experiences an unusual amount of pain at the commencement of any sitting, it is wise to postpone it until another day, or make it very short. Such unlooked-for pain is a useful intimation that the urinary passages are not at this time in fit condition for our purpose, and by acting upon it we may avoid serious mischief.

12. After the first sitting it is generally desirable that the patient should have hot fomentations to the hypogastrium and perinæum, remain in the horizontal position, and pass his water in that position if he can. He should remain tolerably quiet until the débris has passed, which usually happens within three days of the sitting.

13. The removal of débris by injecting and washing out the bladder is to be considered the exception to, and not the rule of, practice,

Lithotrity with rapid evacuation.

Recently Professor Bigelow has published an account of a different method of lithotrity from those hitherto practised.[1] By this operation the stone is entirely crushed and removed in a single sitting protracted to a duration of one or two hours or even longer.[2] The patient is to be completely etherised, the bladder is to be filled with about 10oz. of water, and after the stone has been crushed all the fragments which can be removed are to be evacuated by an aspirating apparatus fitted to a large straight tube, then the lithotrite is to be re-introduced and the remaining fragments further pulverised, and so on till the stone is entirely removed. Dr. Bigelow relates fourteen cases thus treated with one death, and Sir H. Thompson has during the last three years operated on 104 individuals by this method with only three deaths, and, as far as can be judged at present, with a complete cure in all the cases which recovered. The average age of the patients was 62½ years; sixty-two of the calculi were uric acid, four oxalates, nine mixed calculi, and twenty-nine phosphates. No cases of mere phosphatic concretions, merely requiring the introduction of the lithotrite without any aspiration, have been included.[3]

With such experience, to which the favourable testimony of many other operators may be added, we can hardly doubt that the removal of the stone by lithotrity and aspiration will to a great extent supersede not only the older methods of crushing, but also lithotomy in the numerous cases in which it used to be recommended merely on account of the size of the stone. The protracted manipulation needed to remove the stone in such cases appears to be a necessary evil more than counterbalanced by the total removal of the stone without any wound. Yet it would be idle to deny that such protracted manipulation must necessarily involve danger. I have seen a patient die with suppuration in the pelvis in whom the operation had been performed quite satisfactorily—although here there was, no doubt, disease of the kidney. But it should be recollected that disease of the kidney is a very frequent concomitant of stone in late life. Great success can only be obtained by delicate manipulation. The instruments should not be larger than necessary, and need not for ordinary stones exceed in size or indeed differ in any respect from those in previous use, except perhaps in the shape of the aspirator, which is now provided with a trap for catching the fragments, more conveniently formed than that attached to Clover's instrument. The length of time required for even a large stone need not usually exceed an hour, though a much longer time has been consumed in cases which have turned out quite well; so that it is better to persevere as long as may be necessary rather than leave any fragment behind.

Removal of foreign bodies.

The lithotrite, or lithotrite-scoop, or some analogous instrument, may often be employed with signal success in the removal of foreign bodies from the bladder. The most common case is where the fragment of a bougie has been broken into the bladder. If the surgeon is called in at once, he may pick up the foreign substance, and generally with ease, and should the piece be small it may come away without any trouble. If large it may be cut into pieces, which will pass of themselves. If treatment has been put off till a crust of phosphate has been deposited on the fragment, the case must be treated like any other case of stone.

[1] 'Litholapaxy, or Rapid Lithotrity with Evacuation,' 1878, from the 'Am. Journ. of Med. Sci.' Jan. 1878.

[2] Sir H. Thompson, however, says that the operation need very rarely exceed 50 minutes.

[3] 'Syst. of Surg.' 3rd ed. vol. iii. p. 302.

More complicated foreign bodies generally require lithotomy, for, even if they could be caught and crushed, the fragments would be very dangerous to the urinary apparatus. Such cases are, as a general rule, very favourable for lithotomy, since there is no disease of the bladder or kidneys (see page 229).

Prostatic calculi have been spoken of incidentally on previous pages. They form small and often very numerous concretions, containing a good deal of animal matter, but consisting generally of phosphate and carbonate of lime,[1] sometimes almost entirely of the latter salt. These small concretions grow into the urethra, and often (I believe usually) do not cause any special symptoms, but they may occasion pain and irritation in making water, and frequent erections and discharges of semen. In such cases they might be detected by careful exploration with the sound and finger. Calculi also may pass out of the bladder and lodge in the prostatic urethra, producing total or partial retention, and a calculus may grow from the bladder into the urethra (vesico-prostatic calculus) thus dilating the neck of the bladder and causing more or less incontinence. It often happens, however, that the urine can be retained, though not for any long period, although a calculus is projecting out of the bladder. In the female, also, I have known a stone grow out of the bladder into the urethra, and produce incontinence of urine. Removal of calculi from the prostatic urethra by means of forceps, is spoken of, and in the case of the small prostatic concretions it seems physically possible, and the attempt may be justifiable; but in all cases in which the stone is known or believed to have a vesical origin it should, if possible, be pushed back into the bladder with a lithotrite, and crushed. If this is not possible, median lithotomy is indicated.

Prostatic calculus.

Vesico-prostatic calculus.



FIG. 387. A stone impacted in the neck of the bladder of a child aged three. The stone seems to fill the prostatic urethra, but there is no history of complete retention of urine, though there had been great difficulty in passing water for about eight weeks. The child was brought to the hospital to be operated on, when symptoms of scarlet fever showed themselves and he died in a few days. The bladder is small and thickened, the ureters are dilated. There is some malformation of the bladder, one side of it being much larger than the other, and from its apex projected a small elongated cyst (through which a bristle passes) which had every appearance of being a pervious portion of the urachus.—From a specimen in the Museum of St. George's Hospital, Ser. xii. No. 87.

Stone in the urethra is a common cause of retention in boys. It is in all ordinary cases carried down from the bladder, though it is said that stone has formed in a pouch or diverticulum behind a stricture. The impaction of a calculus does not necessarily cause retention; in fact, a smooth and small calculus may produce very few symptoms, its impaction being due merely to its being turned with its longest diameter across the urethra, and when it happens to turn the other way it will come out. But large and sharp stones or fragments of stone give rise to much suffering, and unless removed early much mischief will follow from abscess, extravasation of urine, urinary fistula, &c. In some cases the obstacle to the passage of the stone depends on spasm of the urethra, and relaxation of this spasm by opium and the warm bath will prove successful. The patient should be directed to hold

Stone in the urethra.

[1] Their chemical composition, according to Dr. Wollaston, is phosphate of lime 84·5, carbonate of lime ·5, animal matter 15·0.

his urethra in front of the stone as long as possible while passing his water, in order to increase the force of the jet. If the stone be lodged far forwards patient and gentle attempts at extraction with the forceps will often succeed, especially if the stone can be manipulated so as to turn its long axis along the urethra. If such attempts are unsuccessful, and the stone is near the scrotum, it may be better to push it into the perinæum and cut down on it there, though I must say that I have not seen the harm which some surgeons describe as resulting from cutting into the urethra in the penis. If a catheter is passed into the bladder, tied in and left open, the wound is pretty sure to heal. Stones impacted far back will not, probably, be extracted by the forceps. A free incision should be made on them, keeping the left thumb or forefinger pressed on the urethra behind, to prevent them from slipping into the bladder.

CHAPTER XXXIX.

DISEASES OF THE MALE ORGANS OF GENERATION.

AFFECTIONS OF THE TESTICLE AND ITS APPENDAGES.

Congenital malformations.

THE congenital malformations of the testicle with which we are concerned in practice relate chiefly to irregularities in the descent of the gland, The cases reported of multiple testicles seem to be apocryphal: cysts in contact with the testicle having been mistaken for additional testicles.

There are cases in which the testicles are imperfectly developed or even entirely absent, though the patient retains sexual feeling and power. Such persons, however, are probably sterile. Their possession of sexual power is accounted for by the fact that the vesiculæ seminales are present, being developed along with the vas deferens and epididymis from a different part of the embryo.

Retained testis.

More common, however, and in a surgical point of view more important, is the retention of the testicle either in the abdomen or in the inguinal ring. Such retained testicles do not, in the opinion of most pathologists of the present day, secrete seminal fluid, i.e. fluid containing spermatozoa, so that the patient is sterile, if both testes be retained, though there is no reason why he should be in any respect deficient in sexual power.[1]

With hernia.

When a testicle has only descended into the inguinal ring, or when it descends very late into the scrotum,[2] a portion of bowel very often adheres to it, and may easily become strangulated, especially, as in these cases, the internal ring is often very deep and narrow. And in other cases, though the testicle does not descend, the gut may come down into the scrotum, and, of course, may be strangulated there (see Fig. 309, p. 654). In all cases of hernia with retained testis, the first care of the surgeon is to replace the hernia if possible. If the testicle adheres to the hernia and the latter is reducible, so that the replacement of the bowel involves the reduction of the testis also into the abdomen, or into the groin, this is a matter of but little importance, provided a truss can be worn and the risks of hernia obviated. Even if the pressure of the truss were to cause atrophy of the testis, this is not an objection to the practice, since the testicle is probably useless from the beginning. But very often the hernia will be found irreducible, or the truss cannot be borne. In such cases a bag truss must be fitted. If an operation becomes necessary the surgeon will probably embrace the opportunity to remove the testicle, which is useless and in the way.

Such retained testicles have not unfrequently been known to be the seat of cancer,[3] and in other cases of hydrocele. Gonorrhœal orchitis is peculiarly painful when the testicle is retained in the canal.

There are also instances in which the testicle, instead of descending into

[1] There is, however, much difference of opinion on this subject. The evidence on both sides is fully stated in Mr. Jacobson's article, 'Syst. of Surg.' 3rd ed. vol. iii. p. 465.

[2] Sir A. Cooper relates that he has seen the testicle descend as late as seventeen years of age, and Dr. Humphry speaks of a case as late as forty.

[3] Dr. G. Johnson, 'Med.-Chir. Trans.' vol. xlii. Mr. Hodgson, 'St. George's Hospital Reports,' vol. ii.

the scrotum, has passed into the perinæum, or even through the saphenous opening into the groin. The knowledge of these rare anomalies will be useful to the surgeon in examining cases of supposed hernia or perinæal abscess. They have been operated on with success. See Annandale in 'Brit. Med. Journ.' Jan. 1879.

In other cases the testicle is inverted in its descent, so that the cord lies in front of it, and the tunica vaginalis behind. This fact has its importance, as we shall see, in the practical surgery of hydrocele.

The persistence of the funicular canal is a fact of as much importance in hydrocele as in hernia.

The malformations of the penis derive their practical importance from the condition of the urethra and bladder, and have been spoken of on pp. 787, 800.

The *diseases* of the male organs may be divided into those of the testicles, scrotum, and penis. The vesiculæ seminales might perhaps be added, but their affections are not well understood, and the diseases of the prostate are treated along with those of the urinary organs, with which they have a nearer connection than with those of the generative system.

Hydrocele. The diseases of the testicles will be first considered—of these perhaps the commonest is *hydrocele*, a collection of fluid in the tunica vaginalis, the result of over-secretion or passive dropsy.

No symptoms attend the formation of a hydrocele, so that any swelling in the testicle which forms painlessly and gives no inconvenience except that occasioned by its weight is suspected to be a hydrocele till proved otherwise.

The forms of hydrocele are various, corresponding to the condition of the tunica vaginalis and its funicular process.

In the ordinary condition the tunica vaginalis is entirely separated from the peritoneal cavity by the whole extent of the scrotum and inguinal canal. It only covers the front and sides of the testis, extending somewhat under the epididymis and around its head, but is reflected forwards from the sides of that body so as to leave its posterior part free. Consequently, when this cavity is distended with fluid, which constitutes the common hydrocele, the swelling lies in front of the testicle and above it (Fig. 313, p. 655). The testicle may be sometimes felt at the back of the tumour; the scrotal cord is perfectly free. The collection of fluid is often too tightly bound down to permit of the feeling of fluctuation; it is commonly transparent, though often not so, in consequence of the thickness of the sac. It is pyriform, and if the patient is intelligent he will have noticed that it has begun from the bottom of the scrotum and extended upwards. When punctured a greenish or yellowish serum is drawn off, which is rich in albumen, so that it coagulates on the application of heat or nitric acid like the serum of the blood. The causes of hydrocele are not well understood. It is a common complication of chronic inflammation of the testicle (hydrosarcocele), and a certain amount of hydrocele also usually accompanies acute orchitis. Its inflammatory origin is testified also by the fact that it is not infrequently referred to an injury. Yet in most cases of pure hydrocele nothing of the kind can be traced. It is spoken of vaguely as a 'local dropsy,' but certainly has no connection or affinity with general dropsy.

Diagnosis. The diagnosis of this form of hydrocele from hernia is usually easy—in fact obvious—for, as the cord is free between the tumour and the external inguinal ring, no confusion between hernia and hydrocele, or any other uncomplicated tumour of the testis or its coverings, is possible. But hydrocele, or any other

scrotal tumour, may be combined with hernia, as shown in the diagram above referred to (Fig. 313); and then in the part caused by the hydrocele transparency will be found without impulse or reducibility, and in the hernia opacity with impulse and probably with reducibility. If the hernia is strangulated, the characteristic symptoms of that condition will demand the reduction of the bowel either by taxis or operation, and after this has been accomplished the nature of the tumour will become plain. But old hydroceles with a thick non-transparent sac are not easily distinguished from solid tumours of the testicle; on the contrary, are sometimes almost indistinguishable from them. I once assisted a surgeon of great experience in an operation on a case, which I had not seen before, where he proposed to remove the testicle on account of supposed malignant disease, which on incision turned out to be a simple hydrocele; and I was once consulted in a similar case, where, remembering this, I avoided the same error only by a puncture with a trocar after the patient had been prepared for the operation. So also with hæmatocele, as to which the reader is referred to the section on that disease.

The treatment of simple hydrocele may be palliative or radical. The latter cannot be devoid of pain, and involves some, though a very trifling risk. Consequently, many persons prefer to go on with the palliative treatment, or, in plainer terms, to have the hydrocele tapped from time to time instead of attempting its cure. Tapping a hydrocele is a very simple proceeding, though it is sometimes mismanaged. The back part of the scrotum is to be drawn backwards so as to make its front surface tense. A part of the skin is to be chosen free from large veins, and the trocar is to be plunged in boldly, inclining upwards, in order to avoid the testicle. This gives, it may be said, no pain, and after the swelling has been emptied the canula is withdrawn and a bit of strapping applied. When the fluid has re-collected to such an extent as to cause pain and dragging on the loins, this little operation may be repeated, or the radical cure may be undertaken.

Tapping.



Fig. 388. Tapping a hydrocele. After Liston. The probable position of the testis is indicated by a dotted line.

When the fluid has all been withdrawn, the condition of the testis must be carefully examined, for before the emptying of the sac it is difficult if not impossible to be sure that the gland itself is healthy, and if it be not so it will be vain to try and cure the disease by any measures directed solely to the tunica vaginalis.

In this, the common, method of tapping a hydrocele the testicle is supposed to be behind, as it is in ninety-nine cases out of a hundred. But there are rare instances in which the position is reversed; and the gland lies in front of the fluid. I once saw such a case in which a trocar had been twice thrust into the testicle in attempts to empty the hydrocele. This reversal of the position depends on one of two causes: (1) The hydrocele may have been tapped, and in this operation the front surface of the testicle may

Cases in which the testicle lies in front.

have been punctured. In consequence of this the testicle contracts an adhesion to the front of the hydrocelic cavity, and when the fluid re-collects the testicle lies at the front of the tumour and the fluid laps round each side of it, so as to appear behind it, though this is hardly the case in strictness of speech; or (2) the hydrocele may really lie entirely behind the testicle as a consequence of congenital peculiarity, for it seems that sometimes the testis gets twisted as it were in its descent into the scrotum, so that the epididymis and cord are in front of the gland and the tunica vaginalis behind it; and if in a case like this hydrocele should occur it must, of course, be altogether behind the testicle. Such a position could not be detected if the tunica vaginalis were thick and opaque; but in ordinary cases careful exploration by transmitted light will distinguish the position of the testicle, or the elasticity of the part will convince the surgeon where fluid is to be found; or palpation may elicit sensations in the patient which will enable him to point out the situation of the gland. Fortunately, if in an obscure case the testicle is punctured, no serious mischief usually follows; the error, however, is a discreditable one when, as commonly happens, it is the result of pure negligence.

Radical cure.

The radical cure of hydrocele used to be effected by laying the sac freely open, and this is sometimes still necessary in cases of obstinate recurrence.

Incision of the sac.

I have had occasion to perform the operation and to see it performed by others. It used to be prescribed to stuff the wound with lint in order to excite suppuration, but this is painful and superfluous. It is only necessary to keep the wound open by gently separating its lips from time to time and the cavity will fill up.

Port-wine injection.

Commonly, however, the injection of the sac suffices. The old plan was after withdrawing the fluid to fill the sac with port-wine and water in equal parts (the French use alcohol and water in various proportions) and keep it in the sac till the patient felt a good deal of pain and began to feel sick and faint. Then the canula was opened and as much of the fluid as would run out was allowed to escape. The modern plan (introduced by the late Sir R. Martin) is less troublesome to the patient, and is usually effective, though, I think, less certain to cure the disease than the port-wine injection. Two

Iodine injection.

drachms of an equal mixture of Tinct. Iodi and water are passed into the emptied sac and left there. The effect of the injection of a hydrocele is always a smart attack of inflammation, the sac usually filling to the same size as before, and with a good deal of redness of the skin and pain. But as this subsides the part resumes and retains its natural size, at least if the operation is successful. As the injection of iodine is painful and not absolutely certain to cure the disease, other methods have been employed. The one which seems to me most promising is that introduced by Dr. Levis of Philadelphia.[1] The deliquesced crystals of the acid are used, i.e. the pure acid with about 5–10 per cent. of water or glycerine, and from half a drachm to a drachm (according to the size of the sac) of this is passed into the emptied sac, by means of a graduated syringe with a nozzle long enough to project through the canula into the sac. Very little pain or reaction is produced at first, but after about twenty-four hours the usual inflammation follows, though in the cases I have operated on (less than ten in number as yet) not to the usual extent. It also seems to subside more rapidly. Dr. Levis says that he has used this injection in private and hospital practice for nine years.

[1] The Treatment of Hydrocele, and Serous Cysts in general by the Injection of Carbolic Acid.—'Transactions of the Med. Soc. of the State of Pennsylvania,' 1881.

and met with no case of carbolic poisoning, nor any in which it has failed to effect a radical cure. In three of these the iodine injection had failed.

After the cure of hydrocele the tunica vaginalis is sometimes obliterated by adhesions; but this is not necessary for cure, and is believed not to be the usual result; though precise information on this head can hardly be obtained, since such operations never prove fatal and have been forgotten before the patient's death even if his body is examined. Should the hydrocele recur after the iodine or other injection, as it sometimes does, the best plan is to inject it with port-wine or with sulphate of zinc lotion (gr. iv. to ʒi.) used in the same way as the port-wine injection, and if it still recurs to lay it open; but in these cases very careful examination of the testicle should be made, to ascertain whether it really is a case of simple hydrocele.

Setons are also used in the cure of hydrocele, but the silk seton seems to me a more severe measure than incision, and the silver seton is very uncertain in its action. I have seen it in some cases produce too little inflammation to cure the disease, and in others such violent symptoms as are out of proportion to the gravity of the disease, ending in fact in one unlucky case in death. Setons.

The other forms of hydrocele depend on the condition of the tunica vaginalis and its funicular process in respect of their obliteration.

When the whole funicular process remains open and the communication is not large enough to admit a piece of bowel, the serous secretion of the peritoneum may distend the scrotal pouch and form a *congenital hydrocele*.[1] (Fig. 308, p. 654). Congenital is distinguished from common hydrocele by its shape and extent, and by the fact that the fluid can be returned, though often only slowly and with much difficulty, into the belly, and from hernia by its transparency[2] (which, I believe, is almost, if not quite always present), and by the different sensation which the surgeon feels in reducing it. Congenital hydrocele.

The treatment of congenital hydrocele consists in evacuating the fluid with a fine trocar and endeavouring to procure the obliteration of the patent canal by making continuous pressure on it near the external inguinal ring by means of a truss, which should be worn night and day if possible; and as fast as the fluid re-accumulates the puncture should be repeated. Most cases, I believe, ultimately recover. If not, the communication will probably enlarge and hernia will ensue. In France it seems common to treat congenital hydrocele by injection with alcohol, pressure being maintained on the ring while the sac is being injected; and Mr. Curling speaks favourably of iodine injection, while Mr. Jacobson proposes to lay open the sac (under antiseptics) and allow it to granulate up, or even to remove it, as in the radical cure of hernia recommended by Mr. M. Banks (p. 643), but the gravity of the disease seems hardly sufficient in most cases to warrant measures which cannot be free from considerable risk.

[1] It must be recollected that this is not a necessary consequence of the persistence of the communication if it be very small, as shown by the case of Sir A. Cooper, quoted on p. 653.

[2] It must be remembered that a hernia cannot under ordinary circumstances be transparent, since both the viscera and the omentum, which form its contents, are themselves perfectly opaque. In very rare cases the hernial sac is dropsical or distended with clear serum—'hydrocele of the hernial sac.' This usually occurs after the obliteration of the neck of the sac by the pressure of the truss, or its partial obstruction by adherent omentum. The difficulty of diagnosis is great, as may be seen by reference to Mr. Curling's chapter on this subject in his treatise on 'Diseases of the Testis.' The feeling of impulse at the neck of the sac, the history of the case, and the different relations of the testis to the tumour from those which are met with in hydrocele, are the points to be chiefly attended to.

Infantile hydrocele.

Infantile hydrocele is very common. The tunica vaginalis and its funicular prolongation are distended with clear serum, but the scrotal portion of the funicular process is separated from the peritoneal cavity by a septum at the external ring (Fig. 311, p. 655), so that the fluid will not pass into the peritoneal cavity whatever force be used and however the canal may be straightened out; but very careful examination in this respect is necessary before the hydrocele can be confidently said not to communicate with the peritoneum, so easy is it to close a small communication by any folding over of the parts; and then what is really a congenital may easily be mistaken for an infantile hydrocele. Infantile hydrocele generally disappears spontaneously or after the application of a stimulating lotion of arnica or hydrochlorate of ammonia or tincture of iodine to the skin; or it may be punctured subcutaneously or otherwise. There is no objection to injecting such a hydrocele, but it is rarely necessary.

Hydrocele of the cord.

Hydrocele of the cord proceeds from the effusion of serum into an unobliterated portion of the funicular process (Fig. 314, p. 655), or perhaps from the growth of an independent cyst in the cellular tissue of the cord. It is commonly met with in children or boys about puberty, and causes a small round tense swelling in the course of the cord, separate from the testicle, and therefore easy to distinguish from common hydrocele or any tumour of the testis, and if also distinctly separable from the external inguinal ring, equally easy to distinguish from hernia, and therefore unmistakable. But as the cyst may extend up to, or beyond the ring, there is in such a case a very great resemblance to hernia; so that I have seen a case of the kind treated for hernia at one of our truss societies. Careful examination, however, will show that the supposed hernia cannot be made to return into the belly, though there is no strangulation; that the impulse it receives is much less than a hernia would have; and that it forms a small rounded swelling instead of a long tubular one; and if the child be taken into a dark room, and the candle be dexterously arranged, transparency can usually be detected in spite of the smallness of the cyst and fatness of the part. There is then no further doubt. But if, with a cyst situated so high up there should be any symptoms of strangulation, it would be right to cut down on the tumour and open it; and in fact, whenever there is any considerable doubt, the same course may be justifiable, rather than expose the child to the annoyance of wearing a truss unnecessarily.

These cysts are easily curable by injection with a small quantity of tincture of iodine, say ʒj. of a mixture of equal parts of the tincture and water, or ʒss. of the pure tincture. I have also cured them by a silver seton, but with more inflammation and distress, and more readily and surely by cutting the cyst open and leaving it to fill up.

Besides these encysted hydroceles of the cord, which are common enough, diffused hydrocele of the cord is spoken of, forming a long, sausage-shaped tumour around the whole cord; but if it occurs it is exceedingly rare. Dr. Humphry says that no such case is known to have presented itself in modern times, and refers to the works of Pott and Scarpa for all that is known about it. Their accounts will be found in a condensed form in Mr. Curling's work.

Encysted hydrocele of the testis.

Encysted hydrocele of the testicle consists in the formation of a cyst in contact with the testicle itself and not with the cord. The usual position of these cysts is in the head of the epididymis, and they generally contain spermatic fluid. But they are found in other situations, as between the tunica

vaginalis and albuginea; and they may contain, not the milky fluid which results from the admixture of semen, and which presents spermatozoa under the microscope, but the same nearly watery secretion as is contained in the cysts of the cord. Their diagnosis from common hydrocele is formed either from their position, for they do not envelope the testicle like common hydrocele, but lie above, behind, or at the side of it like a double testis; or from the milky or watery nature of their contents, which contrasts forcibly with the albuminous serum of ordinary hydrocele. The way in which semen gets into these cysts is not, perhaps, fully understood; but there is no question that in many cases a distinct communication has been seen between the cyst and the tubes of the epididymis; and if we allow that in the cases where no opening has been found there was really no opening, still it might have been present at one time, and then have become obliterated. In the watery cysts, however, no such communication can at any time have existed. It seems on the whole most probable that these cysts originate in different ways, either as outgrowths (or buds as it were) from the tubes of the epididymis, the opening of which may or may not become obliterated, or as independent formations in the cellular tissue of the cord, which afterwards may or may not form a communication with its seminiferous tubes. It has also been suggested, but on pure hypothesis, that they may be overdeveloped remains of the Wolffian body which have not become connected with the testicle. A much more probable hypothesis is that put forward in a very interesting paper by Mr. S. Osborn in the St. Thomas's Hospital Reports for the year 1875. He traces the development of these cysts to the 'hydatid of Morgagni,' a small cystic body which is always found between the testis and the globus major, and is the remnant of the Müllerian duct. The paper and the preparations depicted in it are well worth studying.[1]

The treatment is the same as that of common hydrocele; but as the tumour is usually smaller and fills more slowly than in hydrocele of the tunica vaginalis, there is less motive for undertaking the radical cure.

Loose bodies in the tunica vaginalis.

The cavity of a hydrocele sometimes contains a loose body. This, as Mr. Osborn points out, may be formed by the hydatid of Morgagni becoming degenerated into a solid tumour, much as an enlarged bursa does, and then dropping off its peduncle; and Dr. Humphry has pointed out a similar process for the development of these movable bodies, and has given an interesting example of the recognition and removal of one of them during life by incision.[2] In a case by Sir B. Brodie a patient who had one of these loose bodies used to complain of intolerable pain after the operation for tapping; and they often set up a certain amount of irritation, and no doubt either produce or keep up the effusion of fluid into the tunica vaginalis. They should, therefore, always be removed when they can be recognised. I have no doubt that they may arise from various causes, just as loose cartilages do; and their structure bears much analogy to that of the loose bodies in the joints. In Dr. Humphry's case the loose body, which was the size of a bean, was composed of 'compact fibrous layers encircling an earthy nucleus.'

Hæmatocele.

Common hæmatocele is a collection of blood in the cavity of the tunica vaginalis. It usually follows on some sprain or injury whereby a vessel is ruptured on the internal surface of the membrane, and this is often the case when hydrocele is already present. The same thing happens sometimes in

[1] See also Mr. Jacobson's Essay, p. 496.

[2] 'Syst. of Surg.' 3rd ed. vol. iii. p. 514.

Hæmatocele of the cord.

hydrocele of the cord and in encysted hydrocele, which by some blow or injury becomes filled with blood, or converted into hæmatocele. In the cord, however, this is so uncommon that I think it not worth while to spend more space upon it. In the tunica vaginalis it appears common enough. Hæmatocele may be produced by a blow or a strain in the previously sound condition of the organ, giving rise to hæmorrhage into the cavity of the tunica vaginalis, or by similar injuries, or the puncture of the trocar, in cases of hydrocele, and perhaps by spontaneous rupture of or exhalation from, some vessel in the lining of the sac.

The tumour has generally a somewhat more rounded shape than a hydrocele, is heavier, less homogeneous, part of it being knobby and semi-solid, is perfectly devoid of transparency, and often accompanied by a dark colour of the scrotum, due to blood sugillating into the subcutaneous tissue.

Diagnosis.

The diagnosis is anything but easy. It is hardly too much to say (at least I may say it for myself) that the surgeon can never be sure of the diagnosis of a hæmatocele till he has punctured it. It may be a solid tumour of the testis (perhaps inflammatory, but more probably malignant), or a hydrocele with a thick sac. The diagnostic signs are as follows:—Chronic orchitis is generally accompanied by a more definite history of its causation than hæmatocele, i.e. it follows directly on acute orchitis or as the result of a blow, the tumour having been always solid, and increasing gradually; or after syphilis, with some other distinct syphilitic symptoms. Cancer of the testicle advances more rapidly, has a greater tendency to spread up the cord, and is accompanied with more pain. [I do not speak of advanced cases of cancer complicated with enlarged lumbar glands, where there is no difficulty in diagnosis.] Hydrocele is wanting usually in the history of injury and of sudden increase to a certain size, at which when a hæmatocele has attained it usually stops. But the reader will see at once that all these signs are dubious; and an experience of the complexities of practice and the uncertainties of patients' histories will enable him easily to judge how dubious they are. It is, however, more especially the early stage of cancer which bears the strongest resemblance to hæmatocele.

Notwithstanding, however, the difficulty experienced in diagnosing hæmatocele, there are many cases in which the symptoms and history point strongly to the correct conclusion; and in any case where there is a real necessity for operative interference a preliminary incision will settle the matter, and can do no harm.

Sometimes hæmatocele, if neglected, grows to an enormous size, producing atrophy of the testis; at other times the blood degenerates into a turbid, grumous mass, very like the contents of the small intestine.[1]

Treatment.

In very old cases of hæmatocele probably the safest and best course is to remove the whole tumour with the testicle; but as a general rule it will be sufficient to lay open the tumour by a free crucial incision, turn out all the clots, tie any vessels in the thickened tunic which bleed freely enough to require it, and allow the cavity to granulate up.[2] At the same time it should be remembered that the operation is a severe one, and in old or unhealthy persons it should not be lightly undertaken. I have seen death follow it. It

[1] I once saw a surgeon, on opening a hæmatocele of this kind, start back, fancying for a moment that he had laid open a hernia.

[2] Some singular cases are recorded by Mr. Curling in which the testicle was inverted and lay in front of the hæmatocele, so that the surgeon having in his incision seriously injured the testicle or vas deferens, was obliged to perform castration.

is said that cases of recent hæmatocele occur in which the absorption of the blood can be procured by rest, evaporating lotions, ice, &c. I have not met with such cases, but am quite willing to believe in their occasional occurrence. If the case is recent and the blood entirely fluid, iodine injection may be successfully employed.

Acute orchitis.

Orchitis, or inflammation of the testicle, is divided into acute and chronic. If the word orchitis were construed so literally as to restrict it to inflammation of the body of the gland, excluding the epididymis, we might say that acute orchitis is almost always caused by a blow, by gout, or by metastasis in mumps, since the familiar acute inflammation of gonorrhœa is properly epididymitis, but this is in ordinary language included in the term orchitis. The inflammation also which follows from impaction of calculus, after lithotrity, catheterisation, &c., is originally, like gonorrhœal orchitis, situated in the epididymis.

Gonorrhœal orchitis, or epididymitis.

Gonorrhœal orchitis usually occurs somewhat late in the disease, and often after the discharge has more or less subsided; whether it occurs from inflammation spreading up the vas deferens to the epididymis, or from some nervous 'sympathy,' the nature of which is obscure, is as yet undecided.

It commences when in its severest form with rigors, sickening pain in the back and loins as well as in the testicle, heat and redness of the scrotum, swelling and tenderness of the epididymis, and distension of the tunica vaginalis with serum and lymph. The body of the testicle becomes more or less affected as the disease progresses. The inflammation appears to be at first seated in the intertubular connective tissue, afterwards the tubuli themselves become loaded with lymph.

On the subsidence of the disease it seems not very uncommon for the tubuli seminiferi, and probably also the large excretory tubes of the vas deferens, to be choked up by this lymph, so that the testicle is left useless; and if both testes have been affected the patient is sterile,[1] though the testicles may not be wasted, nor the patient deficient in sexual vigour.

Treatment.

The treatment of gonorrhœal orchitis is now far less severe than it used to be. Very many cases are found to get perfectly well with no more active treatment than rest in bed, with the testicle wrapped up in a warm poultice.[2] In other cases the treatment by the application of ice is most successful, and is recommended on the high authority of Mr. Curling. When there is much pain opium should be freely given. Leeches sometimes also relieve pain if followed by warm bathing. Free purging is very desirable, and if much inflammatory fever be present antimony in moderate doses is indicated. In the initial stages, when confined to the epididymis, the disease may sometimes be arrested by carefully strapping the part, according to Dr. Humphry. When the pain is gone, but swelling lingers, strapping is most beneficial if the pressure be well and equally applied, but this is an art which all people do not possess.[3] The application, also, of mercurial ointment below the strapping, or rubbing in a small quantity of mercury, often removes the swelling.

[1] See Jacobson, op. cit. p. 527.

[2] Dr. Humphry says that without treatment or even rest, most cases would end in resolution.

[3] To strap a testicle, separate it from its fellow and pull the skin tight, put the first strap round the scrotal cord, the next perpendicular to the first between the testicles, the third half overlapping the first, and the fourth the second, and so on till the whole gland is equably covered. The skin ought not to be pinched anywhere between the straps, nor should the pressure be painful anywhere. The straps should be about half an inch wide.

Puncture of the testis in orchitis.

I never saw any need for puncturing the testicle, and I believe the treatment to be altogether unsurgical and unnecessary—unsurgical because it exposes the patient to some danger of permanent injury to or atrophy of the testis, without any corresponding risk in the disease itself, and unnecessary because relief can be obtained without any such violent proceeding. Mr. H. Smith is the chief advocate for the puncture, which he at first spoke of as a free incision into the tunica albuginea, though this description was afterwards modified into a lancet puncture. I have no doubt that a free incision would cause atrophy of the testis in a large proportion of cases. The lancet puncture is, I dare say, usually harmless (and the more so because I believe it often does not reach the testicle at all), but it must also be quite inefficient. The pain in orchitis is commonly (though not with indubitable accuracy) referred to the tension of the tunica albuginea. If we accept this view, how can a small puncture relieve this tension? The tunica albuginea is not a hollow bag, which if pricked in one part will collapse in its whole circumference. In order to give any effectual relief to its tension it must be freely incised, and then the inflamed and swollen substance of the testis will only too probably protrude through the incision, and the patient will have every reason to regret the activity of the treatment. However, in reality the body of the testis is rarely so much affected as the epididymis, and how can a puncture in the body of the testis relieve inflammatory swelling of the globus major? If it be replied that as a matter of fact the puncture is often followed by diminution of the pain, I am quite ready to admit it. The reason is no doubt because the tunica vaginalis (which is almost always acutely inflamed) is punctured, and this being a hollow bag can be at once emptied by even a small puncture, with temporary relief to the tension. But such relief is only temporary—it does not in any way tend to cure the epididymitis—and so far as it enables the patient to get about it prevents him from obtaining the great requisite of treatment—rest. Orchitis in almost every case is caused, and in every case is aggravated, by exertion or excess of some kind, and the first dictate of common sense as well as of sound surgery is to put the man to bed and keep him quiet. I have often watched the relief which follows on this simple proceeding in cases where the pain has been very severe. Relief thus obtained is nearly as quick and far more lasting than that which follows on puncture, and it tends to cure the disease itself, while exertion and every kind of excitement tend to aggravate and perpetuate it. For which reasons I altogether deprecate the practice of puncturing the testicle itself, and I believe the puncture of the tunica vaginalis to be in almost all cases superfluous and unadvisable, though it has been advocated by some good surgeons,[1] and in the somewhat rare cases in which suppuration is imminent, or has already commenced, is urgently indicated.

The orchitis which follows on injuries, mumps, or other causes, must be treated on the same general principles, and Dr. Humphry gives a useful caution to examine the urethra in cases of recurrent orchitis, since the recurrence often depends on the presence of stricture, and can only be obviated by its cure. The acute orchitis of mumps is remarkable as being an affection of the body of the gland, and as being liable, occasionally, to be followed by total wasting of the organ; but as far as recorded cases go this unfortunate

[1] On this subject I may refer the reader to a correspondence between Mr. H. Smith and myself in the 'Lancet' for January 1876; to an article by Mr. Hutchinson in the 'Med. Times and Gazette,' April 22, 1871, in which he seems to speak with approval of the puncture of the tunica vaginalis; to a letter by Mr. Macnamara in the same sense in the 'Lancet' for 1876; and to Mr. Curling's standard work.

event does not seem ever to occur on both sides. Acute (or subacute) orchitis also happens occasionally in gout and rheumatism.

Chronic orchitis is frequently the remains of the acute disease, but its more usual cause is syphilis. Chronic orchitis.

It consists in a knotty enlargement of the various lobes of the gland, proceeding from infiltration of lymph into their connective tissue, and this knotty infiltration has given rise to the name 'tubercular testis,' a somewhat unfortunate one, since it seems to be intended to apply to a disease which ought carefully to be distinguished from that which proceeds from scrofula, to which the designation 'tubercular' would be more appropriate. As the disease progresses it involves the whole organ in a common hard swelling, in which all distinction between testis and epididymis is lost, and the whole becomes uniformly hard and heavy. There may also be more or less fluid in the tunica vaginalis, forming the 'hydrosarcocele' of the older authors.

The ultimate end of the disease is various. Not unfrequently, if successfully treated, it seems to be entirely cured with no resulting mischief to the gland whatever; at other times the affected portion of the gland shrinks and becomes atrophied as the liver does in cirrhosis, or suppuration ensues, and then the abscess may either heal or hernia testis may follow.

Chronic orchitis is a disease of slow progress, and it seldom attains a large size. It is hard to distinguish it at first from scrofulous orchitis, except by the concomitant affections in the latter. And in some cases where chronic orchitis has attained a rather large size it is very difficult to distinguish it from malignant disease in its earlier stage. In fact, the physical appearance is nearly identical, and I have seen the mistake made by the greatest masters of surgical diagnosis. The history and rate of progress of the diseases are different, but histories are often very deceptive. The effect of a course of mercury, however, and the progress of the disease while that course is being administered, will enable the surgeon to form the diagnosis, though, probably, if it do turn out to be cancer, the nature of the case may not be ascertained with certainty before the patient's health is broken down by the combined effect of the disease and the mercury. The presence of other syphilitic affections will be a material aid to the diagnosis. Diagnosis.

In chronic orchitis, whether syphilitic or no, mercury is generally successful. The best plan seems to be to keep the patient in bed and bring him under the influence of calomel and opium, slowly but fully, till the gums are slightly tender. After about three weeks of this general mercurial action it may be kept up by inunction of mercurial ointment into the scrotum, and then iodide of potassium and sarsaparilla should be given. Finally, when the patient gets up the testicle should be strapped. Treatment.

Scrofulous disease of the testicle consists in the deposit of tubercle in and around the tubular structure, usually of the epididymis, with thickening and enlargement of the vas deferens, but it is sometimes confined to the body of the testis, as in the instance here figured (Fig. 389). The tubercle softens and makes it way to the skin, causing first adhesion of the layers of the tunica vaginalis, then redness and thinning of the coverings of the scrotum, and finally, bursting as a chronic abscess, through which often the tissue of part of the testicle protrudes, and sometimes almost the whole gland. It is frequently associated with general phthisis or with some other tubercular affection, and very often both testicles are diseased. Occasionally, instead of softening, the tubercles wither and calcify, leaving the organ little affected. Scrofulous orchitis. Hernia testis.

It has been noticed that in some of these cases an examination by the rectum will disclose tubercular deposit in the vesiculæ seminales and sometimes in the prostate.

This is only another form of chronic orchitis, and accordingly, it is not always easy to diagnose it from the common or the syphilitic orchitis; in fact, nothing prevents a strumous patient from having syphilis, so that the two diseases may well be mixed together. And as the diagnosis of chronic orchitis from cancer is sometimes difficult, so is also (but much more rarely) that of strumous orchitis. On this head, however, enough has been said above.

In the treatment the general management of the constitutional condition is far more important than any local treatment; in fact, the disease requires



FIG. 389. Strumous orchitis, confined to the body of the testicle. One small tubercle is seen in the centre of the organ, and a larger mass on its surface, which has softened, and forms a large hernia of the testicle. The tunica vaginalis is thickened and distended. The epididymis and cord are healthy. The disease was removed at a comparatively early stage, on account of the irritation it caused to the patient, who was phthisical. He rapidly improved in health after the removal of the testis.

no local treatment unless abscess has formed. Such abscesses may sometimes be incised with advantage, and hernia testis, whether proceeding from strumous or from ordinary chronic orchitis, requires treatment, which will be described immediately. In a few cases, when the testicle is a source of pain and exhaustion to the patient, it may be removed, though, as a rule, this should be avoided. I have, however, removed the testicle under these circumstances more than once from patients in an advanced stage of phthisis, and with very great benefit to the general health.

Treatment of hernia testis.

Hernia testis requires, in the first place, careful attention to the general health; in the next place, strict cleanliness and the removal of all sources of irritation; and, finally, some gentle stimulant to the granulations. Powder-

ing them with the nitric oxide of mercury, and slightly repressing them by strapping with an ointment of the same, is the favourite plan of treatment at St. George's, and is very successful when combined with good diet, rest in the hospital, and the usual remedies for struma when the disease is strumous, as is commonly the case. Other surgeons speak highly of the use of iodoform. Under such treatment as this, the sore usually scars over, and no further interference is necessary. Two kinds of plastic operation are, however, practised in hernia testis. The only one which I have either performed or seen is that which consists in paring the edges of the scrotum, and bringing it over the exposed gland. In order that this may succeed the granulations must previously be brought into a healthy condition, and when this is the case I have obtained a speedy permanent cure in this way. Dr. Pagan, of Glasgow, has also described an operation in which the edges of the opening in the tunica albuginea, which he believes to constrict the herniated testis as the neck of the sac constricts a hernia, are notched with a bistoury and the protruding gland repressed before the skin is brought over it.[1]

Finally, in some extreme cases it may be better, on the whole, to remove the exposed gland.

Cystic disease.

The common cystic disease of the testicle is usually in fact cancer, with one or more cysts in it. But besides this malignant cystic tumour, there are cases of innocent tumour formed of a number of cysts of variable size scattered over the whole substance of the organ.[2] Cartilage is often found mixed with these tumours, as it is with malignant tumours of the testicle. And I have seen a case in which a congenital tumour was developed in the testicle, which contained numerous cysts lined with ciliated epithelium, and in which portions of bone were found. The diagnosis between the innocent cystic tumours of the testicle and malignant disease is very difficult indeed, unless the history points clearly to a non-cancerous formation, and clear serum can be here and there evacuated by puncture. But on removal of the testicle, an operation which must be performed if the size of the tumour requires it, the distinction will be made; and then the patient may safely be assured that the cure will be permanent.



FIG. 390. Section of a specimen of non-malignant cystic disease of the testicle.—From a preparation presented by Mr. Cæsar Hawkins to the Museum of St. George's Hospital.

Enchondroma.

Enchondroma of the testicle is generally associated with cystic disease; in fact, Mr. Curling teaches that the deposit occurs in the dilated tubuli seminiferi, and that the cysts are the dilatations of the tubes. Thus the cartilage

[1] See Mr. Jacobson's Essay, p. 535.

[2] This is said by Mr. Jacobson to be an early stage of sarcoma of the testis.

is found in its initial stage in the form of beads strung together upon the tubes. In other cases, however, the formation of the cartilage has seemed to be more in connection with the lymphatics of the testicle, as in the celebrated case recorded by Sir J. Paget in the 38th vol. of the 'Med.-Chir. Trans.,' and to which reference has been made above (p. 341), where the growth spread up to the great veins and proved fatal. The purely cartilaginous tumours are of somewhat slow growth usually, and of great consistence and weight. They undergo calcification, and sometimes probably cystic transformation. Their removal is plainly indicated, and if they are not mixed with cancer (which, however, they not uncommonly are), the prognosis is good. Mr. Jacobson regards enchondroma as usually an initial stage of sarcomatous disease, a view which, if correct, would form an additional argument for early removal.

Innocent tumours in the scrotum.

Innocent tumours other than inflammatory, cartilaginous, or cystic, are decidedly rare in the scrotum, and as originating from the testicle still rarer. A few scattered instances of what have been described as fibrous or fibro-cellular tumours of the testicle are recorded. Two good examples recorded by Cruveilhier and Mr. Haward are given by Mr. Jacobson (op. cit. p. 341). I have recorded [1] an instance of a fibrous tumour of the scrotum enveloping the testicle, but clearly having no organic connection with it, which had grown gradually during thirty-three years. This might doubtless have been removed without injury to the testicle at an early period, but was so implicated with the cord and gland at the time I saw it, that they were necessarily removed together. As well as could be determined the tumour seemed to have grown in the tunica vaginalis. Several such instances are recorded, and it may be said in general that the fibrous tumours of the scrotum are developed apart from the testicle, though their removal often involves that of the gland.

Cancer of the testis.

Cancer of the testicle is usually sarcomatous, as far as the anatomy of the disease goes, though clinically very malignant. It may, however, be of the encephaloid form. It generally begins in the body of the gland, expanding the substance of the testicle, which is then spread out as a thin layer over the tumour, easily known from the cancerous mass by the seminal tubes which form the bulk of this expanded layer, as well as by its general appearance. There are often large cysts in these tumours, and masses of cartilage are often found here and there in them. The cancer usually obliterates in great part or entirely the cavity of the tunica vaginalis, but it rarely bursts through the skin of the scrotum. It tends more to spread up the cord and into the lumbar glands, i.e. the glands which lie around the aorta and common iliac arteries. The inguinal glands are also sometimes affected, and that not only when the skin of the scrotum is implicated. As the disease progresses (and its progress is usually rapid) the patient's health breaks down rapidly, and death ensues either from the pressure of the mass in the abdomen, or from its interference with digestion, or from fungation, whether of the secondary tumour or of the primary.

Diagnosis.

The diagnosis rests mainly on the fact that cancer is a rapidly increasing solid enlargement of the testicle itself, unaccompanied by inflammation; but the remarks made above in the sections on hæmatocele, chronic and scrofulous orchitis, will show that this diagnosis is by no means easy in the early stage; for at this period there is no cancerous cachexia (on the contrary, cancer

[1] 'Path. Trans.' vol. xx. p. 246.

comparatively often occurs in florid healthy young men)[1] nor any perceptible enlargement of the glands. There is no difficulty in forming a correct opinion in the latter stage of cancer, but then the time for surgical interference will probably have passed. However, with a rapidly increasing solid swelling an exploratory incision is justifiable, all the necessary arrangements for castration having been made.

Castration.

The operation of removing the testicle is a very simple one, and free from danger; at least I cannot recollect a single case of death after the numerous operations of the kind which I have performed and witnessed, though these operations have been performed chiefly on patients exhausted by illness and dissipation, and in those metropolitan hospitals which are falsely said to be so unhealthy.

A free incision is to be made from the situation of the external inguinal ring down to the bottom of the scrotum. The cord is then exposed and the skin peeled off it with the fingers. If the cord should be diseased up to the external ring a director must be passed into the spermatic canal, the aponeurosis of the external oblique divided and the cord followed higher up; but this is very seldom required in any case which the surgeon has selected for operation. The healthy part of the cord is to be caught in a clamp, such as is figured on page 615, and when it has been entirely secured it is divided above the disease, and as far from the clamp as circumstances permit. Then the tumour is rapidly shelled out of the scrotum, and if it adheres to the skin all the adherent portion of the latter is removed as well as a good part of the skin in the neighbourhood. The cutaneous vessels which are large enough to give any trouble are tied, and then the ends of the cut vessels in the cord are picked up and tied. If this is done with the carbolised gut, and the ends of the ligatures cut short, the wound will often heal almost or altogether by first intention.

If a clamp is not at hand, the cord, if it be healthy for a considerable distance below the ring, may be held between the thumb and finger of an assistant with a piece of rag; but this is a very inferior method of securing it. Or the old plan of passing a stout ligature through it to hold it by may be adopted, and, in fact, must be if there is not room to hold it otherwise. I have often seen the cord on its division slip from between the assistant's fingers up into the spermatic canal, and then there is very profuse bleeding, and the surgeon has to slit up the canal and follow and bring down the bleeding stump of the cord with hooked forceps. This danger is avoided by the clamp, provided the division of the cord is not made too close to it, in which case the clamp also is very likely to slip off. I have frequently followed the old plan of tying the whole cord with a strong double ligature, and have not found any of the evils, such as pain, tetanus, &c., which are said sometimes to result from it; but it is a tedious method, as it delays the patient's convalescence, and condemns him to suppuration and confinement to bed during the long period of separation of the ligature. Abroad, the cord is sometimes divided with the écraseur,[2] but this is not a plan which I can recommend, as it takes a very long time, and is far more exposed to the risk of recurrent or secondary hæmorrhage.

Before the operation the patient should be carefully examined as to the

[1] 'Cancer of the testicle makes its appearance at all periods of life, from the earliest infancy to old age, but is most frequent from twenty to forty. It is rare after sixty.'—Humphry.

[2] See a case in the 'Gaz. des. Hôp.' Oct. 30, 1877.

presence or absence of hernia. Unfortunately the immunity from disease which this operation procures in cases of cancer can only be expected to be short. The disease will recur in the stump of the cord, or in the lumbar glands, or in some cases in the opposite testicle, or in remote parts of the body. Still the respite is one usually of complete health, and it amply justifies the operation, even if we believe that life is not prolonged by it. No doubt also in some cases the recurrence is long delayed. Mr. Curling has given four cases in which the patients were well 4, 9, 10 and 12 years after the operation.

Dermal and other fœtal tumours.

I have spoken above (p. 338) of the occasional occurrence in the scrotum of congenital tumours containing bone, teeth, hair, and other structures. They are sometimes, as it seems, at first included in the testicle itself, out of which they grow; but at other times, they have been proved to be separable from the gland. The diagnosis is usually obscure until suppuration sets in around the mass, and exposes a part of it, or till the whole tumour has been removed. This should be done in all cases, for though they have been spontaneously extruded, yet operative removal is far less dangerous and distressing. In the operation, it is reasonable to make an attempt to preserve the testicle, though it will probably be found impossible to do so.

Spermatorrhœa.

The consequences of masturbation, the apprehensions of spermatorrhœa and loss of sexual power, form a highly unpleasant subject, which has become still more disgusting as affording a field for the practices of some of those unscrupulous and degraded charlatans who infest the profession, or who falsely assume a connection with it. These men make money out of the fears of unfortunate youths, some of whom are merely nervous and are frightened at the natural emissions by which the testicles relieve themselves from distension in persons who are not in the habit of sexual intercourse. The majority, however, of the victims of such fears are conscious of having indulged either in solitary abuse or in sexual excesses. A judicious and honourable surgeon cannot be better employed than in delivering such patients from the consequences of unfounded apprehensions, and inculcating the strength of mind and manliness necessary to give up vicious habits which have been once contracted. In a work of this kind it is fortunately unnecessary to dwell on this unsavoury subject. So long as the power of complete erection continues and the patient does not lose semen involuntarily or unconsciously (which is very rare) the genital organs will recover themselves under proper treatment. Very frequently what is mistaken for spermatorrhœa is some slight mucous discharge, the result of irritation of the urethra. Proper treatment, however, involves as its most essential feature the renouncement of the habit of self-abuse, and either abstinence or only moderate indulgence in sexual intercourse. If the patient cannot be persuaded to put this restraint on himself he deserves the ruin that will fall on him. With this, and with tonic regimen and active exercise of body and mind, recovery will be regular and permanent. Real impotence may, of course, occur; but it is very rare. The cauterisation of the prostatic urethra, which is so highly recommended, seems to me often useful, less perhaps from its direct action than indirectly, by making masturbation or venereal excitement painful.

On the whole of this subject, and especially on the morbid fears of impotence and other horrors which haunt the unfortunate victims of 'sexual hypochondriasis,' I cannot do better than refer the reader to Mr. Jacobson's

remarks on 'Functional Disorders of the Testicle and the other allied topics,' op. cit., p. 549 et seq., and to Sir J. Paget's excellent essay on 'Sexual Hypochondriasis,' in his recently published Clinical Lectures.

AFFECTIONS OF THE CORD.

Varicocele.

VARICOCELE is a very common affection, at least in its minor degrees. It consists, as its name implies, in a varicose condition of the pampiniform plexus of veins which return the blood from the testicle into the spermatic vein. Varicocele is far more common on the left than the right side. Various causes have been assigned for this. The left spermatic vein opens into the renal vein at a right angle, while the right spermatic opens into the vena cava obliquely, and it seems possible that this disposition may be somewhat more unfavourable to the circulation in the left vein; but at the most it can only favour the production of the disease; it cannot produce it. Again, the left testicle is usually a little lower than the right, and the vein a little longer. But this difference seems too insignificant to be of any importance. Thirdly, there is the fact that the left renal vein is exposed to the pressure of the fæces in the sigmoid flexure, behind which it lies; and this appears a possible cause of obstruction in the vein. Mr. Gould, in an interesting paper in the fourteenth vol. of 'Clin. Trans.,' conjectures with much probability that the cause of varicocele (which frequently shows itself about puberty) may be some over-development of the veins, or 'a transference of the developmental stimulus of puberty from the testicle to the veins.' It appears often to be caused by the practice of masturbation. The enlarged veins are easily felt in the cord, 'feeling like a bag of worms,' as it is always described, and the description is very accurate as applied to the extreme instances of the affection. When the varicose veins are at all large they can be seen and the disease at once recognised without even touching the skin. Varicocele may be complicated with any other affection of the testicle, or with hernia; but it can hardly, as far as I can see, be confounded with any of them, at least by anyone who has ever seen it before. The swelling, of course, subsides to some extent in the recumbent and increases in the erect posture; but this is utterly unlike the disappearance and return of a hernia. When the veins are large a certain amount of impulse can be felt on coughing.[1]

The enlarged veins are often the seat of some amount of real pain on prolonged standing, and still more often of a considerable amount of nervous pain. The testicle on that side is often smaller than the other, and the patient is often worried (especially if he has fallen into dishonest hands) by apprehensions of impotence. As a general rule, however, nothing can be more unfounded.[2] Sir A. Cooper said with much truth: 'Varicocele should scarcely receive the title of a disease, for it produces in the greater number of cases no pain, no inconvenience, and no diminution of the virile powers.' It follows incontestably, if we believe this—and there are few surgeons of experience who would question it—that the number of cases of varicocele

[1] I must content myself with a mere reference to a variety of varicocele described by Profs. Monod and Terbillon in the 'Arch. Gén.' July 1879, as a concomitant of lymphadenoma affecting the testicle. The subject appears at present to be imperfectly understood. The authors believe that lymphadenoma is the only form of new growth which attacks both testicles at once.

[2] Sir J. Paget goes so far as to say of varicocele: 'I do not believe that it ever produced wasting of a testicle, or impotence, or any such thing.'—'Clin. Lect.' p. 274.

which require serious treatment are very few indeed, and that any surgeon who operates very frequently for varicocele must operate on many cases which he would have done better to let alone. I do not deny that such operations may sometimes be required, under circumstances which I will immediately point out; but the great majority of cases require nothing but a bag-truss. If the enlarged veins should inflame, rest in the recumbent posture with the testicles raised by a small pillow, fomentation, and leeches are indicated. There are cases (probably those in which the upper part of the vein is varicose, and where the enlargement of the lower veins depends on the pressure of the column above) in which a light truss applied on the ring gives relief. Mr. Wormald's plan of drawing a part of the scrotum through a ring of soft metal coated with leather, the ring to be pinched together when the skin has been drawn through it, may be tried; and some surgeons still have confidence in Sir A. Cooper's method of removing all redundant scrotum and sewing it up, so as to give support to the testicle, which, however, must still be also supported by a bag-truss. Nervous pain may be much relieved by convincing the patient of the trivial character of the disease.

Operations for varicocele.

There will remain cases in which the patient will wish for an operation, and that mainly for three reasons—either that he wishes to get into some employment, as the army, from which the state of the veins excludes him (though I believe army-surgeons do not reject recruits for the slighter degrees of varicocele), or he suffers real and considerable pain, or the testicle is wasting. As to the latter point, however, I do not think that any slight difference between the size of the testicles is necessarily a motive for operation. Several years ago I was consulted by a young man with varicocele, who was very anxious to be operated on, the varicocele being rather large and the testicle much smaller than the other. With difficulty I persuaded him to wait, and then, as the testicle did not continue to waste, I advised him to give up the idea, telling him that he might safely marry (as he wished to do), and might rely on it that he had the same chance of offspring as anyone else. He is now the father of a large family, and suffers nothing from his varicocele, which has remained stationary. And we must recollect that such operations are by no means free from danger to life, and that if they sometimes cure the atrophy of the testicle, on the other hand they sometimes produce it. The celebrated instance of Delpech is in point. He was assassinated by a man on whom he had operated for varicocele on both sides, and who had lost sexual power in consequence of the operation. The assassin was executed, and on examination of his body after death both testicles were found flaccid and wasted. This untoward result arose doubtless from obliterating the greater part of the spermatic artery along with the veins. Usually the trunk of the spermatic artery adheres so closely to the vas deferens that as the latter is drawn out of the way of injury the artery follows it and escapes also; but often in dividing the veins a large artery is severed, and the distribution of the spermatic artery is by no means uniform. Numerous cases of death after the operation are known to have occurred; and in cases which ultimately recovered I have seen so much suppuration, sloughing, and other evil consequences, that I have thought the remedy has been much worse than the disease. I would therefore recommend the surgeon to let his patient urge the operation upon him, and even then only to consent when his judgment goes along with the request.[1]

The operation I have generally practised for varicocele is that recommended

[1] See also on this subject Paget, op. cit. p. 68.

by Mr. H. Lee, and which is the same as that which he employs in varicose veins of the leg. The vas deferens is to be carefully isolated and held aside, then two needles are to be driven in beneath the enlarged veins and above the vas deferens at a distance of about an inch from each other. The veins are to be compressed between these needles and the skin by a figure-of-8 ligature wound pretty tightly over the needles, or by an india-rubber band. In the latter case the needle is introduced with the band strung on it, and the band then passed over its point. When the veins are thus secured they are divided subcutaneously in the interval between the needles. In doing this a good deal of bleeding often takes place. This is judged to be arterial when it comes from the upper or cardiac end, and venous from the lower. If it is too great to be stopped by the circular band of strapping which is applied between the needles another needle must be driven in more deeply, either above or below the former (according as the hæmorrhage is arterial or venous), so as to command the vessel which has escaped the needle previously put in. The needles are to be withdrawn in about four days. If matter forms in the scrotum it must have early exit.

Many other operations for curing varicocele are, however, in use. Latterly I have adopted the very simple plan of cutting down on the venous plexus as though it were an artery, by a very small incision, separating it from the vas deferens, and tying it with a kangaroo-tendon. The wound heals over the ligature, which remains buried in the tissues. I lately saw a man so operated on, who seemed to be permanently cured, and the method is so simple and painless that I think it deserves further trial, though my experience is not enough to justify me in speaking confidently about it. Mr. Jacobson (op. cit. p. 570) describes an operation introduced by his colleague, Mr. Howse, in which the varicose portion of the cord is included between two carbolised gut ligatures and excised. This is, however, obviously a very severe proceeding, and Mr. Jacobson records a case in which it was followed by gangrene of the testis. I have seen a similar proceeding adopted without any antiseptic precautions many years ago, in which there was profuse bleeding at the time, and extensive suppuration afterwards.

Tumours in the spermatic canal.

Fatty tumours are occasionally, though very rarely, found in the tissue of the spermatic cord, which very closely simulate omental hernia. The diagnosis can only be formed by very careful examination, showing that the tumour is movable by traction on the cord, and that the fingers can be made to meet round its base; but I am not aware that these tumours have ever been made the subject of operation. Mr. Jacobson refers to two cases from Mr. Curling's experience and to some preparations of fatty and fibrocellular tumours of the cord in the Museum of the College of Surgeons.

Affections of the vesiculæ seminales.

The vesiculæ seminales are occasionally, though very rarely, the seat of acute inflammation and abscess, which in one of the cases recorded proved fatal by inducing peritonitis,[1] in another was cured by timely incision through the rectum.[2] Remembering these cases the surgeon should carefully examine the parts in any case in which pain, fever, tenesmus and shooting pains down the limbs render the occurrence of acute inflammation of these organs probable.

Apart from this rare occurrence the affections of the seminal vesicles are rather matters of diagnostic than therapeutical interest. In tubercular disease of the testes or bladder the vesiculæ are believed often to be the seat of tubercle, and it has now become usual to examine them from the rectum

[1] Mitchell Henry, 'Med.-Chir. Trans.' vol. xxxiii. p. 307.
[2] Jacobson, op. cit. p. 573.

in affections of the testis believed to be of this nature. Prof. Humphry has also met with chronic enlargement of the vesiculæ, and a case is reported in which it was believed (but it seems to me on very imperfect evidence) that they were dilated into a large tumour (Jacobson, loc. cit.). Calculus concretions are also said to have been found in them.

AFFECTIONS OF THE SCROTUM.

Œdema and inflammation.

THE scrotum is very liable to passive œdema both from general and local causes. The chief point in the management of such affections is to see that gangrene is averted by timely punctures and fomentation. Inflammatory œdema also tolerably often occurs from erysipelas, from the contact of urine, and from other causes; and sometimes an abscess forms in the cellular tissue of the scrotum and produces swelling quite out of proportion to the amount of matter in it. An abscess containing only a few drops of pus will often form a large swelling which gives the patient very grave uneasiness, and which I have even known mistaken by the inexperienced for a tumour. Nothing is required but a poultice and a timely puncture, after which the swelling will rapidly subside.

Elephantiasis of the scrotum.

Elephantiasis of the scrotum is a disease of tropical countries, which is only seen here, as far as I know, in those who have contracted it abroad. There it extends to an enormous size, making the patient's life intolerable, in consequence of its weight preventing him from any of the necessary exertions of daily life, and rendering any operation, however desperate, justifiable.

The opportunity of seeing these cases in their early stages, when they might be amenable to pressure or to astringent applications, is hardly ever granted. In the more moderate condition, the surgeon would probably think it better to dissect out all the hypertrophied skin and remove it from the penis and testicles, even if these organs were exposed. Granulations would cover them, and the patient would in all probability be restored to perfect health.[1] The disease appears often to commence with the lymphatic hypertrophy to which reference has been made on p. 572, and is often associated with enlargement of the glands in the groin. It is believed to be often produced by the irritation of the jigger-worm, Filaria Medinensis, in the tissues, and from thence the worms pass into the blood, so that their young can be detected in the blood from any part of the body, or in the lymph which exudes from the distended lymphatics of the scrotum.

I append a representation of the early stage of elephantiasis, caused by lymph-scrotum, which I owe to the kindness of Dr. Rennie of Fow Chow. The patient was a man æt. 24. After the removal of the hypertrophied scrotum, the glandular enlargement rapidly subsided, but the parent worm was not found in the excised scrotum, and its young were still present in the blood after the patient's recovery. When the disease has attained an enormous size, and it is nevertheless thought right to remove it, no dissection is possible, on account of the excessive hæmorrhage. The patient should lie on his back for about half an hour before the operation with the tumour raised, in order to drain it of blood; then the mass must be embraced in a

[1] Two interesting cases were lately reported by Dr. Lloyd, of the Indian Army, in which tumours 65 lbs. and 61 lbs. in weight respectively were removed with success, and the penis and testes dissected out of the mass. In one of these cases the exposed testes hung down nearly as low as the ankles after the operation, yet on convalescence they had completely retracted to the normal level.—'Lancet,' Aug. 29, 1874.

temporary ligature, or in a clamp, in order to restrain the bleeding as far as possible, and the whole mass be removed as quickly as may be, without regard to the genital organs. Such operations, however, are very fatal.[1]

Cancer of the scrotum—soot-cancer, or chimney-sweep's cancer—is an epithelioma which arises from the irritating properties of coal-soot. Wood-soot is not so irritating, and therefore will not usually excite the disease. Hence it is nearly unknown in countries where fires are mostly made of wood; and on the other hand it is not entirely confined to chimney-sweeps in this country, but affects also people who deal much in soot, as gardeners—witness the well-known instance recorded by Earle of the gardener who habitually carried a bag of soot over his arm to dress his beds with, and was affected with soot-cancer on that arm. No doubt the development of this epithelioma is due mainly to the continuance of the irritation, so that constant removal of the soot will hinder it. And therefore in the present day, when people know more of the value of cleanliness, and when even chimney-sweeps wash themselves, this disease has become rarer than it used to be. In fact, it might probably be banished by the sweep using always a clean or freshly-brushed suit, and thoroughly washing himself whenever he comes home. Cancer scroti.



Fig. 391. Lymph-scrotum.

As usually seen it forms a foul epitheliomatous ulcer on one side or sometimes on both sides of the scrotum, with hard, prominent granulations and raised, irritable edge, very frequently complicated with enlargement of the inguinal glands, and in some cases (but rarely) spreading inwards so as to affect the coverings or even the body of the testicle. The diseased tissues must be freely removed, and it is justifiable to do this at any period of the disease, provided the whole of the morbid tissue can be comprised in the incision, even though the testicles should be entirely denuded, or though it should be necessary to remove them as well as the diseased skin. The enlargement of the inguinal glands, if not excessive, constitutes no bar to the operation, nor does it even necessitate the removal of the glands themselves. Constant experience shows that on the removal of the epitheliomatous ulcer the enlarged glands will subside. But if the glands are unusually large and hard it is better to excise them at the same time.

[1] Perhaps I should rather have said, 'were very fatal in past times.' I would refer to an interesting paper by Dr. Turner, late medical missionary at Samoa, on one hundred and thirty-eight cases of this operation with only two deaths.—'Glasgow Med. Journ.' 1882.

If after the removal of the scrotum the flaps of skin can meet over the testicles without much traction the wound should be united. But if not, granulations will cover the testicles, and the cicatrix will form an excellent substitute for the scrotum.

AFFECTIONS OF THE PENIS.

Cancer.

CANCER of the penis is also usually epithelial, and, like cancer of the scrotum, is commonly excited by some irritation, of which the secretion retained behind a congenitally phimosed prepuce is a well-known instance. This liability of persons with congenital phimosis to cancer of the penis forms one motive for circumcision in such cases, though ordinary considerations of cleanliness would be quite sufficient without any such motive.[1]

The only special point in the surgery of cancer of the penis is to distinguish it from secondary or tertiary syphilitic ulceration of the glans penis. And there can be no doubt that in many cases the penis has been amputated for supposed cancer, which has been only this form of ulceration, and that many of the cases of permanent recovery after amputation for supposed epithelioma, have been of this nature. In some cases, again, a confusion may have been made with common warty growth, though this is less likely. The characteristic hardness around the sore and the hard surface, indurated edge, and prominent granulations of the epitheliomatous ulcer will distinguish it from the syphilitic: or if any doubt remains, in consequence of the history or the co-existence of tertiary syphilis, a gentle and prolonged course of mercury will settle the question, and this is best administered in the form of vapour. Sometimes melanotic deposit is mixed with the cancer of the penis, as in a remarkable case which I communicated to the Pathological Society a few years ago, and which is figured above on p. 857.

Amputation of the penis.

When the diagnosis of cancer is clear, the removal of the whole penis at a level well behind that of the disease is imperative.

The old rough plan of simply cutting the organ off with the loss of a large quantity of blood from arteries which the surgeon proceeded afterwards to tie, leaving his patient exhausted by hæmorrhage, would now be unjustifiable. The penis is to be constricted by a clamp (see p. 615), by means of which it can be removed without the loss of a single drop of blood, and all the vessels whose mouths can be discerned are to be tied. Then the clamp should be slightly relaxed, and new vessels will, perhaps, be found which require ligature. Finally the affair is complete without any hæmorrhage or with very trifling loss, and the patient generally recovers without any serious symptom. But unless some care is taken to prevent the cicatrisation of the cut end of the urethra, a most painful stricture will result, and I have seen the orifice of the urethra contracted to the size of a pinhole. This, however, is the result of unpardonable negligence. Always after the amputation of the penis, as soon as the bleeding is suppressed, a director should be passed down the urethra, and the tube should be slit down with scissors on its lower aspect for about half an inch. Then the flaps of mucous membrane should be picked up and attached to the skin, whereby a large valvular opening will be left, that will show no tendency to contract. The old plan, of passing bougies

[1] Sir J. Paget has, however, pointed out that in many cases the orifice of the prepuce may be so stretched by constant gentle traction that the glans can ultimately be exposed, and the operation avoided.

constantly to keep the end of the urethra from contracting, is painful and far less efficient. Circumcision.

Congenital phimosis[1] should always be treated by circumcision. It is a malformation which often leads to considerable irritation, causing many of the symptoms of stone in the bladder, and, as stated before, it undoubtedly predisposes to epithelioma.

The operation of circumcision is a very easy one and requires no special apparatus. A director is passed up between the glans and prepuce on the dorsal aspect, and the knife thrust through the skin and made to cut out. The mucous, or internal, layer is never sufficiently divided by this cut, but should be afterwards incised to the same extent as the outer skin. Any adhesions between the prepuce and glans must be divided. Then the two layers should be removed with sharp scissors by a cut running parallel to the corona glandis evenly all round the organ, leaving just enough of the inner layer to hold the stitches. This is now to be united to the skin by a few points of fine suture. Sometimes the artery of the frænum requires twisting or tying. The wound is to be covered with oiled lint and the penis raised by a pad between the thighs and a bandage. The sutures may be removed on the third day.

When the opening is merely narrowed, but the prepuce is not inordinately long, it is sufficient to slit up both its layers thoroughly and unite the lips of the little wound with sutures. Other affections of the penis.

A few cases of persistent priapism have been recorded from obscure causes, which are best treated by low diet, tartar emetic, or bromide of potassium. In other cases priapism results from disease or injury of the nervous centres, from irritation of the urethra or prostate, or from injury during connection. The treatment, in these cases, must be directed to the cause.

Gangrene has been known as one of the sequelæ of typhus fever, or from paraplegia, and a remarkable case of spontaneous gangrene of the penis, followed by recovery, is recorded by Mr. Partridge in the twentieth volume of the 'Medical Times and Gazette.'

[1] In a curious case mentioned in the 'Brit. Med. Journ.' 1878, vol. i. p. 335, the prepuce is said to have been congenitally imperforate. The malformation was easily remedied.

CHAPTER XL.

SURGICAL DISEASES OF THE FEMALE ORGANS OF GENERATION.

THE diseases of the female organs of generation which come within the province of the surgeon are as follows:—

Malformations; adhesion of the labia.

The commonest malformation (if it deserve so grave a name) is the closure or adhesion of the labia, which is often seen in infants and sometimes passes undetected so as to be presented to the notice of the surgeon in later childhood. Very rarely it is allowed to persist till puberty. It is not unfrequently confounded with imperforate hymen; but the mistake ought not to be committed; for the adhesion is between the labia majora quite in front of the hymen, and it is not, at least in the early years of life, in any sense membranous. After years of neglect it may become tougher and require division with a knife and director; but usually all that is necessary is to pull the parts asunder forcibly, and prevent readhesion by keeping the labia separated with a piece of oiled lint.

Imperforate hymen.

Imperforate hymen is a much graver malformation, especially if (as is almost always the case) it escapes detection in infancy, and the patient first applies for advice when the collection of the menstrual fluid has considerably dilated the cavity of the uterus. Under these circumstances any slight operation, though it is indispensable, involves serious danger. Hence the advice usually given in such cases, to wait for operation till after puberty, seems quite erroneous. If the condition of the parts is discovered in childhood, it is easy and perfectly safe to remove a small portion of the hymen, so as to make an opening into the vagina. But when the uterine cavity becomes distended with menstrual fluid, or with the treacly inspissated remains of such fluid, it is often noticed that after an opening has been made in the hymen, the uterus is thrown into spasmodic action, and the Fallopian tube, which is dilated as well as the uterus, often gives way under this action, causing extravasation of the fluid into the peritoneal cavity, and fatal peritonitis.[1]

Imperforate vagina.

The point of chief importance in these cases is to decide whether the case is merely one of imperforate hymen, or whether the vagina is itself imperforate, and if so, whether the uterus is present or absent. Mr. Jonathan Hutchinson speaks on this head as follows: 'When there is evidence of the retention of menstrual fluid, and therefore of the presence of a uterus, and probably of a vaginal cavity above the occlusion, the case will come fairly under surgical treatment. In the first place, the character of the obstructing medium must be determined. If the obstruction be found within an inch, or two inches of the vulva, and if it be constituted by a membrane, stretched across an otherwise well-formed vagina, the case is probably one of imperforate hymen. In some of these during coughing, the propulsion of the fluid

[1] Let me in passing just call the reader's attention to this amongst other facts which prove that the assertion ordinarily made in anatomical works that the Fallopian tube opens into the peritoneal cavity cannot be true, at least in its literal sense. There is no membrane separating the two cavities, and the one can be made to open into the other by passing a probe: but that they do not communicate during life is proved by the fact that no interchange of fluid ever takes place, however much the peritoneum may be distended by dropsy or the Fallopian tube by retained menses.

downwards may easily be felt, or the distended membrane may even be forced as low as the vulva itself.' [1]

When the obstruction is of only slight thickness there is no difficulty about the treatment. The patient being secured in the lithotomy position a puncture is made into the collection of fluid and this is enlarged with the fingers, director and forceps. It seems that a free opening is safer than a small one, as rendering the forcing action of the uterus less likely to act on the Fallopian tubes. If the obstruction be of considerable extent, a very careful dissection in the direction of the supposed upper part of the vagina must be undertaken, assisted by the finger in the rectum and by a staff in the bladder. If this has to be done deeply, the deeper incisions are more safely made horizontally; but in such cases the operation is doubtless both embarrassing and dangerous.

I do not speak here of cases of doubtful sex, since it is only in the rarest possible circumstances that any surgical treatment is required, and advice as to the sexual relations lies more in the province of the accoucheur.

Vascular tumour of urethra.

A very troublesome affection, and one which is sometimes very difficult to treat, is the small vascular tumour, or urethral hæmorrhoid, which is sometimes found surrounding the meatus of the female urethra. In structure it much resembles a nævus. It occasions a good deal of pain and irritation; leads to a troublesome frequency in micturition; renders sexual intercourse very painful, sometimes impossible, and often bleeds a good deal. Though the disease appears trifling, it is often very difficult to cure, recurring again and again, even after apparently complete removal. Three methods of treatment are in use—caustics, the ligature, and excision. The first are often successful if freely used and if sufficiently strong. The pure nitric acid, repeatedly applied, will often ultimately eradicate the growth, with little pain and no risk or confinement to bed; but it often fails. The actual or galvanic cautery is perhaps more efficient, but requires anæsthesia for its application. If only a portion of the circumference of the meatus is involved in the growth, the latter may be encircled in a ligature passed deeply under its base, through healthy tissues, care being taken to keep the urethra open while passing the ligature, so that the opposite wall of the canal may not be included in it. But the most efficient plan is to dissect the growth out completely with the knife or scissors, taking care to carry the incisions through healthy tissues. No formidable bleeding need be apprehended; but even after this operation, I have seen the growth return, and if it be necessary to cut deeply, there is often partial incontinence of urine, i.e. the patient is obliged to attend to the first desire to empty the bladder, otherwise the urine will very soon pass in spite of her.

Tumours of the labia.

Cystic and other innocent tumours are not uncommon in the tissue of the labium. The cysts are probably always, and certainly they usually are, formed by the obliteration of the duct of a mucous follicle, as is often seen in the mouth. This is sometimes the result of irritation, so that they are not unfrequently developed soon after marriage. They contain a glairy mucus, and they are only troublesome if the patient is in the habit of sexual intercourse, or if they inflame and suppurate, which will occur occasionally. They may be dissected out entirely, or they may be often cured by laying them freely open and stuffing the orifice with lint; or still more certainly by

[1] 'Syst. of Surg.' 3rd ed. vol. iii. p. 394.

clearing away all the secretion and rubbing the interior with caustic. The recommendation of the treatment by laying the cyst open is that it does not render the employment of chloroform necessary, nor are any assistants required. The removal of the entire cyst is, of course, more certainly successful.

Fibrous tumours also form in the labium, and are frequently allowed to attain an enormous size. They then become pendulous, and greatly interfere with all movements, as well as with the functions of the parts. Their removal is sometimes attended with much hæmorrhage, and when this is apprehended in consequence of the size of the mass or its vascular appearance, it is prudent to control the bleeding by a temporary ligature or clamp passed round the base of the tumour beyond the part at which it is removed.

With regard to condylomata, mucous tubercles, and other syphilitic affections of the labium, I do not know that I need add anything to what will be found in other parts of the work.

Hypertrophy of the labia and clitoris.

The tissues of the labia and clitoris are sometimes so much hypertrophied by the constant recurrence of inflammation (whether syphilitic or no), or by elephantiasis, that it becomes necessary to remove the diseased part. In such a case the surgeon should be prepared for free hæmorrhage, and as the base of the growth is usually too extensive to be included in a clamp, the best plan is to pass a number of stout harelip pins through it, and having removed the diseased tissue pretty close to these pins, and tied any large vessels, to pass the twisted suture round the pins tightly enough to restrain any further oozing: or the mass may be removed with the galvanic écraseur.

Cancer of the external parts.

Cancer of the external parts is almost always epithelial. It may occur as a primary disease, and then usually in later life, or it may be developed on a venereal ulcer. It rapidly affects the inguinal glands. Its diagnosis from tertiary syphilitic affection rests on the diffused hardness and irregular surface of the ulcer, and on the affection of the glands, as well as on the history. From rodent ulcer, which is sometimes, though rarely, found in the same situation, it is distinguished by the distinct deposit which is found in epithelioma; but the diagnosis is not of very great importance, since both require the same treatment. Early and complete excision is urgently demanded; although there is great probability of return, much more so than in the analogous disease of the scrotum. The enlarged glands should be removed at the same time, if they are decidedly indurated. When the patient will not submit to the removal by the knife, the use of caustics must be substituted, but is decidedly inferior.

Accidents in parturition.

Ruptured perinæum.

Rupture of the perinæum is an accident following on parturition, and in its highest grades constitutes a serious infirmity which imperatively calls for a surgical operation. The slighter ruptures can often be brought to heal at once by bringing the parts together with a stitch and keeping the legs together for some time after parturition, the strictest cleanliness being enforced. But when the whole tissue of the perinæum, including the sphincter, has been lacerated, so that there is little or nothing to separate the vagina and rectum this will probably not succeed, though even in such cases the attempt should be made. When the rupture is extensive the patient has very imperfect control over the fæces, and often can hardly walk about, from a sensation as if the uterus were coming down. Frequently there is a considerable amount of prolapsus. The operation for the restoration of the perinæum relieves the prolapsus, at any rate for a time; and in some cases of prolapsus, where the vagina is very wide, an operation exactly similar may

be performed with advantage, even if there has been no rupture of the perinæum.

The operation is thus performed. The patient is narcotised, and secured in the lithotomy position; the hair is removed from the labia as far forward as is necessary; the vagina is well opened by means of a duck-bill speculum. Then two quadrangular flaps are marked out with the knife by two lines running parallel to each other along the labia about three-quarters of an inch from the orifice of the vulva, which are joined by a transverse incision just in front of the anus. Another incision is drawn in the middle line from the centre of this last to about three-quarters of an inch inside the vagina, and from this the base of the flap extends in a slanting direction forwards and outwards to join the incision on the labium as far forwards as the surgeon thinks fit. The further forward the dissection is carried the more firm and resisting will the new perinæum be; but it is, of course, undesirable to narrow the orifice too much. After marking out the flaps, the surgeon proceeds to carefully dissect up the mucous membrane and skin from the whole of the part so marked out. On the rectovaginal septum this is facilitated by an assistant putting his forefinger in the bowel. Great care must be taken to remove every vestige of the mucous membrane. Mr. J. Hutchinson inclines to Langenbeck's practice of preserving the flaps, leaving them attached by their base in the vagina, paring them down as much as is necessary, and sewing them together in order to form a covering for the wound. I have not found much advantage from this proceeding in the cases in which I have tried it. When the denudation is complete, and the bleeding (which is often free) has been checked by torsion of the vessels and the free application of iced water, the parts are to be brought together with the quilled suture. For this purpose three or four loops of strong silk or whipcord (according to the depth of the new perinæum) are passed through the whole thickness of the tissues. This is most readily effected by means of a long and very strong deeply-curved needle on a handle—called Baker Brown's needle. The point of this is entered just inside the left tuber ischii and the ligature is carried to the very bottom of the denuded part, and the point brought out near the right tuberosity. The posterior suture should not cross the cleft at all, but should be buried in the rectovaginal septum, when that septum exists. If such a needle is not at hand, the loops can easily be passed with a common curved needle, exactly as in fissure of the palate (p. 582), drawing the ligature across from one side to the other by passing one loop inside the other. There are now a series of loops on the right side of the perinæum, and a series of double ends on the other. A piece of bougie is passed through all the loops, another is laid between the double ends, the patient's thighs are brought together, and these deep sutures are tied very firmly. The pressure on the deep parts forces the cutaneous edges in the middle outwards. These must, therefore, be attached together with silver sutures. Finally, if the vaginal flaps of mucous membrane have been preserved, they must be attached to the front of the wound. In some cases where the rectum has been much lacerated, and there is tension on the parts, it is necessary to make free lateral incisions through the sphincter on either side, sloping towards the tuberosities of the ischium; but this is not required in ordinary cases, and should always be avoided if possible. Ice may be applied in the vagina if oozing of blood occurs after the operation. Before the operation the patient should be freely purged, so that there may be no call to pass motions for some time, and artificial constipation is to be kept up for about a fortnight by the administra-

tion of about ten drops of laudanum twice a day. The water must be drawn off carefully by the surgeon or a dexterous attendant twice or three times a day, as may be necessary. On no account should the patient be allowed to pass any urine for about ten days. Then she may pass it in the prone position. She should be fed as well as her appetite permits. It is scarcely necessary to say that the period immediately succeeding menstruation should be selected; but in spite of this the operation may provoke premature recurrence of the flow, and this may prevent the healing of the wound. There is usually a great deal of foul discharge, which should be carefully syringed away with Condy's fluid. The operation is a very successful one. In some cases fistulous openings are left in the new perinæum after union, but they can generally be easily united again. In one unfortunate case I have seen death from phlebitis and pyæmia, but such a disaster is purely exceptional. The worst which is to be apprehended is that union may not occur, and this will not generally preclude success in another attempt.

American operation for ruptured perinæum.

This method of operating is, as I have said, usually successful, but it is no doubt liable to the two objections raised against it by American surgeons. 1. That the approximation of the thighs tends to encourage and retain the foul discharge. 2. That the deep sutures being passed in a curved direction tend to cut their way out to the skin, and so to cause a want of union in the deep parts of the wounds, whereby a fistulous opening will be found. To obviate this, a new procedure has been devised by Dr. Willard Parker of New York, which may be thus summarily described.[1] The sphincter ani is divided subcutaneously and then stretched. The flaps are pared off the rupture, and the edge of the rectovaginal septum split, so that raw surfaces can be obtained without loss of substance. Then lateral incisions are made into the ischio-rectal fossa parallel to the cleft on either side and carried into the fossa to a sufficient depth to enable the surgeon to press the deepest parts of the fissure together with his fingers passed into these cuts. Deep sutures are then carried straight across the cleft at the bottom of the incisions, and secured over pieces of elastic catheter laid in the incisions, while the edges of the cleft are united by superficial sutures both in the vagina and rectum. The flaps pared off the cleft are preserved, as in Langenbeck's method, to cover the cleft. Then the patient is arranged in bed with the thighs widely separated, and the part operated on only covered with a single thickness of sheeting, air being freely admitted to the wound. A catheter is retained in the bladder.

Prolapsus uteri.

As I have said above, the same operation—viz. to bring the lower part of the vagina together, so as to narrow its orifice and thicken the perinæum, is sometimes advisable in prolapsus uteri; but as the weakness which leads to prolapsus is more in the parts above the uterus than in those below it can only be looked on as an accessory measure. The most important part of the treatment of extreme prolapsus is rest in the horizontal position with the uterus completely reduced. If this can be insisted on for a sufficient time, most cases of prolapsus will be found to be manageable—i.e. though not cured, the patient will be restored to fair comfort and a certain amount of activity by the use of the pessary. If the orifice of the vagina is very wide, no doubt the operation above described will assist in maintaining the position of the uterus; but unless care is taken afterwards, the external parts will certainly yield to the pressure of the uterus, and the patient will be as bad as ever again.

[1] See a case reported by Dr. Stimson in the 'New York Archives of Clinical Surgery,' vol. i. p. 25.

An ingenious and very promising operation has recently been introduced into practice by Dr. Alexander, of Liverpool,[1] with a view of bracing up the uterus from above—viz. to cut down on the external abdominal rings and 'wind up the slack' of the round ligaments by cautious traction, until the position of the uterus is felt to be remedied. The ligament is then stitched to the tissues around the ring, and the loose ends attached to each other, or rolled round two pieces of wood, which are fastened together in the middle line. Four cases are referred to in which the operation was performed with success.

Vaginal cystocele.

The stretching of the vagina in parturition or some accidental imperfection of its muscular structure may so weaken its walls that a kind of partial hernia of the bladder through them is produced. This is called 'vaginal cystocele'—a bulging tumour in the roof of the vagina, which disappears when the catheter is used, and pressure on which may cause the escape of urine. The patient often suffers from some difficulty in making water and irritation of the bladder. The remedy consists in reducing the projecting bladder entirely, then paring a lunated edge of the vagina on each side, bringing the edges together in the median line, and keeping the bladder empty by means of the catheter retained in the urethra till the vaginal wound is soundly healed.

Vaginal fistulæ.

Vesicovaginal and rectovaginal fistulæ are lesions which are caused by parturition, and generally by the prolonged pressure of the fœtal head, though in some cases by direct laceration, either in the passage of the fœtus or by instruments.[2] As most of these injuries are accompanied by loss of substance cicatrisation has often taken place around the seat of perforation, and the vagina is narrowed and puckered by scars. In such cases the first step towards cure is to divide such cicatrices and keep the vagina dilated until the parts have healed. Vesicovaginal fistula is, on the whole, easier to cure than rectovaginal, at least in uncomplicated cases; but it is sometimes complicated with injury to the uterus or the urethra, which hardly permits of entire recovery. Thus the sloughing may have implicated the os uteri so that the bladder and uterus form almost one cavity, or the urethra may be entirely separated from the bladder or even altogether destroyed. In such very severe cases it may, perhaps, be better to abstain from operation altogether, and merely provide the patient with a urinal, giving her instructions to wash the parts well out with dilute mineral acid as often as is necessary to prevent the formation of sabulous concretions. In other cases an imperfect cure may be effected by uniting the back wall of the vagina to the anterior lip of the fissure, so that the uterus and bladder fall into one cavity and the patient menstruates through the urethra. I have seen cases in which this obliteration of the vagina has taken place spontaneously, so that the os uteri was completely hidden. But in the common cases in which there is no great loss of substance and the fistula does not involve the uterus, a cure may generally be obtained, though it is often necessary to repeat the operation several times.

Operation for vesicovaginal fistula.

The operation is thus performed: the patient is narcotised and placed in the lithotomy position[3] the vagina thoroughly exposed by the duck-bill

[1] 'Med. Times and Gaz.' April 1, 1882.

[2] In one very singular case related in Dr. Emmet's work on 'Vesicovaginal Fistula,' that lesion was caused, not by any accident of parturition, but by the accidental explosion of a pistol which had fallen on the ground at the woman's feet.

[3] In America the prone position on the hands and knees is often adopted, and the patient is frequently not under anæsthesia.

speculum, and the os uteri is gently dragged down as far as possible with a vulsellum, so as to get the fistula well within reach. Then the whole of the mucous membrane of the vagina is pared away around the opening, the bladder being interfered with as little as possible, and the sutures are passed so as to take up only the tissues in the vagina and not lodge the sutures in the bladder. The object is to bring the vesical mucous membrane together as closely as possible, but not to leave any suture in the cavity which can conduct the urine into the wound. The fistula is brought together longitudinally, transversely, or obliquely, according to circumstances, so that there may be as little tension as possible on the sutures. The sutures can be secured by twisting them with the 'wire twister,' which is a stem carrying a small cross-piece of metal having a hole on each side. The ends of the wire are passed through these two holes. The suture is run up as tight as necessary, and then by rotating the handle the ends are securely twisted. This instrument enables the operator to tie the sutures at any depth where the fingers could not reach. The cleft having been completely closed, if any tension exists it may be possible to relieve it by dividing cicatricial bands in the neighbourhood, and then an S-shaped catheter of soft-metal is placed in the urethra, and will keep its place by its own shape, or the catheter may be tied in: a bag is attached to it and changed as often as necessary, or the tube is left opening into a vessel below the bed. This catheter must be gently changed twice a day at first, and then every day; but the sutures need not be removed for an unlimited time. After a fortnight if no water has passed into the vagina the patient may be relieved from the catheter, and in another week the sutures may be examined and if all is healed may be gently withdrawn. If the opening is narrowed but not closed, a few weeks must be allowed to elapse, until all irritation has long subsided, before the operation is repeated.

Operation for recto-vaginal fistula.

The operation for rectovaginal fistula is exactly the same in principle, the great object being to exclude the sutures from the rectum, so that no air or matter from the bowel may get into the vaginal wound. The bowels, as in ruptured perinæum, must be kept from action for about a fortnight, and if there is much tension on the sutures it may be necessary to divide the sphincter. Careful syringing of the vagina is very necessary to prevent the accumulation of foul discharge around the healing wound.

Polypus uteri.

Uterine polypi are sometimes quite small and almost sessile, growing from one of the lips, or near the cervix uteri, and consisting of the enlarged glandulæ Nabothi, or of hypertrophied mucous membrane, or cellular tissue. These tumours bear some analogy to the common mucous polypi of the nose. They never attain any large size; but may cause a good deal of inconvenience from hæmorrhage at irregular intervals, and from leucorrhœa. Their removal can never involve much difficulty or danger. The tumour being well exposed is to be twisted off, or, if more sessile, removed with the scissors, bleeding being repressed by the application of perchloride of iron or the cautery, before the patient is allowed to recover from anæsthesia.

The ordinary polypi, however, consist of fibrous tissue mixed with unstriped muscle. They grow from the muscular wall of the uterus, and often attain an enormous size. When they pass into the cavity so as to assume the form of polypi, they usually become detached from the muscular tissue of the uterus, and are completely covered with mucous membrane, though this is not always the case. Though they may cause very great hæmorrhage,

they are not usually in themselves very vascular. They are peculiarly prone to calcareous degeneration, and preparations exist showing such tumours converted almost entirely into an earthy mass covered by the mucous membrane.

There are, again, other polypi much looser and more vascular than these, which are sarcomatous in structure, and prone to obstinate recurrence after removal; and malignant disease will sometimes grow in a pendulous form like polypus; but both these events are rare.

The general subject of fibrous or fibromuscular tumour and polypus of the uterus belongs more to obstetrics than to surgery; but a few words must be said about the removal of these tumours. Polypi, i.e. the pendulous tumours attached to the interior of the uterus, may be removed with ease when their attachment can be exposed, and this is usually near the os uteri. And even if the surgeon cannot penetrate to the seat of implantation of the polypus, he may be sure that any small remnant of the neck of the polypus which he may have been obliged to leave will wither away. Small polypi, or those whose neck is thin, may be safely removed by torsion. The patient is to be narcotised, and the polypus being well exposed is to be grasped near its root with a vulsellum forceps, and slowly twisted round till it is loose. If the neck is so thick that this would not be expedient, the wire écraseur[1] may be used to divide the neck, or the galvanic écraseur may be used with still less risk of hæmorrhage or of unhealthy inflammation. The old plan of passing a ligature round the base with Gooch's double canula, and leaving the canula containing the tightened ligature in position, is now, I believe, almost abandoned. It has its advantages, however, for tumours with a very thick neck, since the tension of the ligature can be gradually increased as it cuts into the base of the tumour.

Enucleation of fibrous tumour.

Embedded fibrous tumours may be removed by enucleation, but as this is a very dangerous and uncertain operation, it should only be used when the patient is in great danger otherwise of dying from hæmorrhage. The os and cervix uteri must be previously dilated with tents, and the uterus dragged down by gradual traction as near the external parts as possible, so as to bring the tumour well into view. If the latter is covered by uterine tissue, this must be divided by the knife, and then the tissue of the tumour must be separated from that of the uterus with the finger, or any convenient blunt instrument, sufficiently to allow of the implantation of a strong pair of vulsellum forceps in its substance. Then the tumour is to be gradually dragged outwards, the uterus being pulled down and everted more or less until the whole growth can be separated, when the uterus is to be returned.

Hysterotomy.

Again, fibrous tumours of the uterus may grow upwards towards the peritoneal cavity, and these sometimes soften and simulate ovarian tumours, as will be afterwards pointed out. In other cases, without any softening the growth proceeds to such an extent as to become dangerous to life from its pressure, or to render it impossible for the patient to perform any of the ordinary duties of life. Under such circumstances the operation of removing the tumour together with a portion or the whole uterus, or even the ovaries also, has been often performed and with a fair amount of success, though I need not say that the gravest consideration of the symptoms, and of the probable danger of leaving the case to itself, is necessary before so very dangerous an operation is undertaken. In the only case in which I have

[1] This is an écraseur in which the chain shown in Fig. 286, p. 615, is replaced by a noose of stout wire; in using this, or the galvanic écraseur, it is essential to divide the tissues very slowly.

myself operated, the operation was undertaken in the mistaken belief that the tumour was ovarian, and it proved immediately fatal.

The operation resembles ovariotomy in its early steps. The tumour having been completely exposed, and freed from adhesions, if it has any, is to be tapped, if it has softened in any part, in order to facilitate its extraction, or if lobulated, portions may be removed with the écraseur to diminish its bulk. When the base is reached it may, in some cases, be secured with a strong clamp, in others divided by means of the écraseur. The operation is now frequently undertaken. In some cases it necessarily involves the total or partial removal of the uterus and its appendages. The indications for its performance are sometimes (though not usually) profuse and dangerous menorrhagia, more frequently persistent pain in the tumour, or its constant growth, and the pressure it produces on neighbouring parts. Some surgeons think that if the pedicle can be drawn up into the wound and secured outside the abdominal cavity, the patient's chances of recovery are much more promising.[1] Sir S. Wells, however, teaches that the great element of safety in these operations is the careful closing of the peritoneal cavity by sewing together the divided edges of the peritoneal coat of the uterus, in situ, as well as the parietal peritoneum, so as to obviate any percolation of fluid from the wound into the peritoneum.[2]

Oophorectomy.

The growth of uterine tumours is often suspended by the cessation of ovarian activity, and from the observation of this fact it has been proposed to remove the ovaries in cases in which the patient is suffering severely from the symptoms of fibrous tumours of the uterus, which it seems too dangerous to excise. The ovaries have also been removed for the cure of neuralgia, menstrual irregularities and aggravated hysteria. The operation is called oophorectomy, or Battey's operation. The ovaries may be removed by an incision though the vagina, or as is more common in this country, by cutting into the peritoneum in the median line, as in ovariotomy. The pedicles are tied with carbolised silk or gut, and dropped back into the abdomen.

Excision of os uteri for cancer.

Cancer of the uterus commences not uncommonly at the os, and in some cases it is detected at a period when it has not spread too far for removal. In such cases much benefit has, no doubt, sometimes been produced by the excision of the diseased structures. The operation is, however, a dangerous one, and in most cases the relief is only temporary. Still, if the surgeon can be sure of the diagnosis,[3] if the disease has not spread to the vagina, and if the general health is still good, it is his duty to make the attempt.

The parts may be removed with the knife or the whipcord or galvanic écraseur, and the preference for one over the other method depends in a great measure on the shape of the mass. The uterus must be gently drawn down as far as possible. If the knife or scissors is to be used, the uterus must be

[1] Dr. Bantock reports twelve cases—in four, where the pedicle was secured within the abdomen death took place in every case; while eight, where the pedicle was kept outside secured at the lower angle of the wound by Koeberle's serre-nœud, supported by two stout harelip pins, recovered.—'Brit. Med. Journ.' March 25, 1882.

[2] 'Brit. Med. Journ.' Sept. 4, 1880.

[3] Mr. Hutchinson says: 'It is not by any means an easy matter in many cases to make a confident differential diagnosis between a simple or venereal ulceration of the os uteri and one of a malignant nature in an early stage. The tendency of the latter to bleed, its warty and thickened edges and fœtid discharge, are the chief symptoms on which to rely. The surgeon must notice especially whether there be any tendency to new growth, and if practicable a small portion of the edge should be removed for microscopic examination. Pain, if severe, is a very suspicious sign.'

commanded by a ligature of stout wire driven through both its lips, and the part in front of the wire cut away in a conical shape, the wound being bevilled towards the uterus. The actual cautery and perchloride of iron must be at hand to repress hæmorrhage, and the wire can be made use of to tie a compress of lint steeped in the perchloride over the wound if necessary.

The application of the écraseur is facilitated by passing needles through the uterus just behind the part to be removed and slipping the chain over these needles.

Ovarian tumours.

The ovary is liable to tumours of all kinds. The solid tumours are fibroid or malignant. The fibroid tumours are difficult of diagnosis from similar tumours of the uterus, which are sometimes pedunculated, and attain a very large size. The fibroid tumours also are at first difficult to distinguish from the cancerous, but the different rate of growth will settle the question ultimately. No surgical interference is advisable in solid tumours of the ovary. Those which are innocent will probably cease to grow, and the patient will ultimately become accustomed to their presence, while in malignant disease an operation would do nothing but harm.

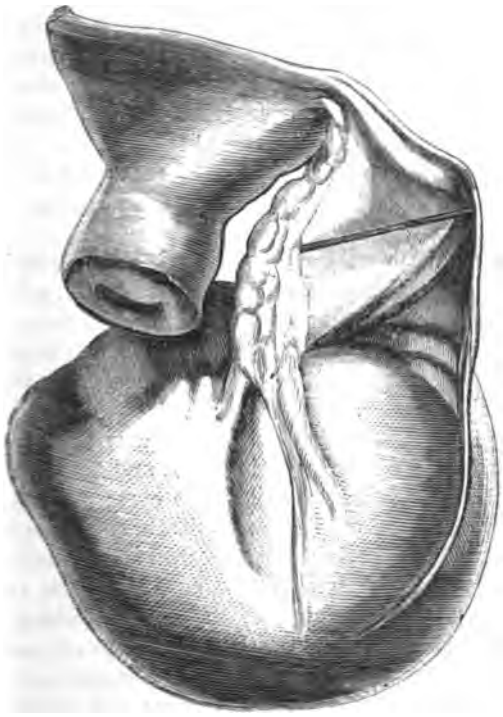


FIG. 392. A watery cyst in the broad ligament of the uterus, which is perfectly separate, both from that viscus and from the ovary. The ovary and its ligament are seen lying over the tumour on the side next the uterus, and the Fallopian tube stretched over it on the other side. The ovary is perfectly normal.—St. George's Hospital Museum, Ser. xiv. No. 151.

Cysts of the broad ligament.

But the ovarian tumours with which surgeons are most concerned are cystic. These cysts are serous, colloid, or dermal. The serous cysts are unilocular or multilocular. The unilocular cysts are occasionally situated not in the ovary itself but in the broad ligament, and result, it is believed, from degeneration of the remains of the Wolffian body or of the duct of Müller.[1] They seldom attain a size large enough to call for surgical operation, though one containing eighteen pints was successfully removed by Mr. Cæsar Hawkins, and is preserved in the museum of St. George's Hospital. In the ovary cystic tumours attain an enormous size. Like cystic tumours in other organs they are either simple single cysts, or proliferous; and the latter are either merely cystigerous (multilocular cysts) or with a solid intracystic growth, which may be of a sarcomatous nature. Other compound cysts contain colloid matter, and are sometimes spoken of as instances of 'alveolar cancer.' Mr. Hutchinson,

[1] See Osborn, in 'St. Thomas's Hospital Reports,' 1875.

however, points out that there is no proof that any of the forms of ovarian tumours are really cancerous except the encephaloid, although the more compound the tumour is, and the more active the intracystic growth, the more does it approach in clinical characters to malignancy. Dermal cysts (p. 338) occur here more frequently than in any other situation, but are indistinguishable from the other forms before operation, unless there is a history of congenital origin.

The character of the fluid contained in ovarian cysts varies greatly. The cysts in the broad ligament usually contain nearly watery fluid, as the encysted hydroceles of the testis sometimes do; but the true ovarian cysts contain a fluid rich in albumen, which is generally less serous than the fluid of peritoneal dropsy, and is very commonly thick and glutinous, like thick gum. It also often contains a good deal of cholesterine. Often it is very deep in colour. Sometimes it is seropurulent, and occasionally is unmixed pus. Suppuration in an ovarian cyst is accompanied in some cases by definite symptoms, constant pain, acute tenderness, some fever, and daily rise of temperature, but it occurs also without any such symptoms. I have recorded one such case in the 'Medico-Chirurgical Transactions,' vol. lv., and some time since I assisted at the removal of a dermal cyst of the ovary which contained pure pus, and in which there had been no suspicious symptoms whatever.[1]

Suppuration in ovarian cysts.

The gradual growth of an ovarian cyst produces what is called ovarian dropsy, i.e. a distension of the belly with a very large quantity of fluid, which occasions much the same symptoms as peritoneal dropsy, viz. shortness of breath, inability to take exercise, œdema of the lower limbs from pressure on the large veins, and sometimes pressure on the bladder, causing irritation, or in rare cases difficulty in making water.

If the disease is allowed to run its natural course it may prove fatal from the effects of its pressure, causing difficulty in taking food, and wasting in consequence of the loss of albuminous material into the cyst; or it may burst into the peritoneal cavity, and then usually causes death, though a few instances have been recorded in which the fluid was absorbed again from the peritoneum; and it is even possible that spontaneous cure may thus take place. In rarer cases the tumour may ulcerate into the bowel, bladder, or vagina, and this also is almost sure to produce death. In some rare cases, as it seems, the tumour may cease to secrete, and the fluid even may be to a certain extent reabsorbed. The suppuration of the tumour will probably lead to its ulceration, and this must almost necessarily be fatal.

Terminations of ovarian dropsy.

Thus we see that the progress of ovarian dropsy is, speaking generally, to death, though its rate of progress varies greatly.

The diagnosis of ovarian dropsy is not by any means easy in all cases, as is seen by the mistakes which are known to occur in the practice of even experienced ovariotomists. The first question is as to peritoneal dropsy. Peritoneal dropsy depends on disease of the kidneys, heart, or liver, so that it is necessary in first taking charge of a case of supposed ovarian tumour to ascertain that these viscera are healthy.[2] Then the physical examination of

Diagnosis.

[1] I would refer the reader to the lectures of Sir Spencer Wells at the College of Surgeons, for the chemical and microscopical characters of ovarian fluid.—See 'Brit. Med. Journ.' June 15, 22, 1878.

[2] It is true that disease of these viscera does not necessarily preclude the occurrence of ovarian dropsy, but it would at any rate in most cases contraindicate any attempt at removal of the ovary.

the abdomen differs in peritoneal and ovarian dropsy. In the former the whole abdomen is uniformly dull, unless the abdomen is so little distended that the transverse colon floats to the surface and its resonance is perceptible. In the latter the transverse colon is quite buried, but the flanks are resonant and the line of the cyst can often be traced by making the patient turn from side to side, and observing how the resonance to percussion advances or recedes. The tumour can also in many cases be felt in the pelvis by examination from the vagina or from the rectum; and very frequently the surrounding cysts can be felt as hard masses in the wall of the principal tumour. In cases of doubt decisive information may, very likely, be obtained by tapping, for the appearance of the dense, sticky, gum-like, and often deeply-coloured fluid which is often found in ovarian cysts is quite different from the greenish serum of dropsy.

Another source of error is mistaking a softened fibroid tumour of the uterus for an ovarian cyst. In a case of this kind which happened to myself as much as a gallon of fluid was contained in the softened fibroid, and the mobility and relations of the tumour exactly resembled one of the ovary. But if an accurate history can be obtained it will be found that there has been flooding, the uterine sound will probably discover that the cavity of the uterus is elongated, and the tumour is not fluid, but semi-fluid, so that, though a good deal of fluid can be obtained from it by tapping, it does not run out freely as from a cyst.

Large cysts are also found in the kidney, and these have been operated upon by mistake for ovarian dropsy. Such tumours, however, generally present more towards one flank than ovarian tumours do, their contents are more or less urinous, and if the hand can be got into the rectum (page 629) the difference in their relations may probably be perceived.

Pregnancy has been mistaken for ovarian dropsy, but in most cases from haste or carelessness. Whenever the patient is of child-bearing age the possibility of pregnancy should not be overlooked, and careful examination should be made for its usual signs. It is more common and less discreditable to overlook pregnancy when it complicates ovarian dropsy; but even in cases of decided ovarian tumour, if the patient is married or is likely to be pregnant—i.e. if the menses have not appeared for some time—the breasts should be inspected, the abdomen carefully auscultated, the os uteri examined, and 'ballottement' searched for.[1]

Lastly, tumours of various kinds, chiefly those in the omentum, and even phantom tumours, have been mistaken for ovarian cysts; but a careful surgical examination will prevent any such error. Phantom tumours very commonly disappear under anæsthesia.

Treatment. Paracentesis.

When the diagnosis is settled the question of treatment occurs. There are, in the present day, for ordinary cases of ovarian tumour, only two methods of treatment worth discussing, viz. tapping and excision.

In selecting between these two plans of treatment a great consideration is the age of the patient. Ovarian cysts are sometimes detected in early life; the dermal tumours are probably always congenital, though they do not usually show till later in life; and other cysts may be developed in childhood. It would be impossible to expect prolonged life in such cases, except after ovariotomy. When, on the other hand, ovarian disease appears late in life, which is rare, the patient is probably better advised in avoiding ovariotomy

[1] Pregnancy does not contraindicate the performance of ovariotomy when the symptoms are urgent.

much will depend on the sequelæ of a first tapping, which ... and hardly ever causes any bad symptoms. After- ... fills only slowly, the patient may be better advised in ... rather than running the risk of the radical opera- ... tapping is by no means devoid of danger, and in cases ... ovariotomy is on the whole far preferable, and ... without any preliminary paracentesis.

... performed. The patient should have been well purged, ... covered with a pair of warm drawers. The room ... A large band is to be passed round the belly of ... for the incision. She should be in the recum- ... The bladder should be empty. Full anæsthesia ... an incision is made in the linea alba from a ... above the pubes, and this is deepened by ... till the peritoneum is exposed. The peritoneum ... fluid very commonly escapes. The surgeon ... fingers, and sweeps them round over the cyst ... that he is really in the peritoneal cavity, ... adhesions.[2] These, if present, are gently separated ... until the whole hand is introduced, and the cyst is ... sides. Now the trocar is plunged into the cyst. ... which goes into a pail on the floor. As the cyst ... with a vulsellum and draws it forward, so ... as much as possible outside of the wound in ... assistants take care that the trocar does not slip. ... introduced a trocar the end of which is hollow and can ... and which has a set of hooks on each side. ... with the escape of the fluid it is drawn into the ... and thus the canula is firmly fixed. I have used this ... but if the cyst wall is thin the hooks are liable to ... better to trust to gentle traction with blunt forceps. ... and the cyst collapses the surgeon passes his hand gently ... of the tumour to ascertain that there are no adhe- ... them carefully if there are, and to deliver the cyst. ... the operation the operator may find reason to extend ... as high as the ensiform cartilage.[3] At the ... on each side) keep up guarded pressure on

... bichloride of methylene; but ether seems to have all the ... liable to cause sickness and not producing depression, while ... safer than methylene.

... concerning the presence or absence of adhesions in most cases ... by a certain crackling of fluid in them, and may often be ... previous pain or other symptoms of peritonitis. But in all ... suspected. Their existence to a moderate extent does not ... prospect. Sir Spencer Wells is in favour of opening and ... making any attempt to separate the adhesions, believing ... mistaking the peritoneum for the cyst-wall. Other operators ... adhesions in front before opening the cyst. Doubtless either ... has its advantages in appropriate cases.

... make the incision longer than necessary. It is true that it is far ... to enlarge an incision than try to remove a large tumour through ... Sir S. Wells shows that when the mass can be removed through ... the mortality is considerably less than when the wound ...

either side of the abdomen, so that the intestines may not protrude. When the first cyst has been emptied it may be necessary to puncture others in the same way before the tumour can be delivered, and in doing so the escape of cyst-fluid into the peritoneal cavity is still more probable. Or the tumour may be adherent to the liver or omentum above, to the intestines behind, or to the wall of the abdomen or pelvis. These posterior adhesions are the most formidable complication in ovariotomy, especially those to the intestine. The omentum contains large vessels, and it may be necessary to tie it with catgut before freeing it from the tumour; otherwise there is little trouble in dealing with omental adhesions. Adhesions to solid viscera are not generally very formidable, but the intestine is sometimes almost imbedded in the wall of the tumour. In such a case the peritoneal lining of the tumour must be slowly and carefully peeled off along with the bowel. Clamps of various forms should be at hand, so that any broad band of adhesion may be securely clamped while it is divided and its vessels tied with catgut. This appears preferable to searing the bleeding surface with the actual cautery, though this is a plan adopted with success. Finally, the tumour having been freed and its remains delivered through the wound, its pedicle must be secured. Three ways are in use for this purpose, viz. to fix a clamp on the pedicle, outside the wound, to divide the pedicle with an écraseur, cauterise it if necessary and drop it back into the pelvis, or to tie the pedicle with carbolised silk, cut the ligature short, and remove the tumour. The use of the clamp was at one time almost universal, but it is now I believe entirely given up; nor do I know that anyone, at least in this country, employs the écraseur. The intraperitoneal ligature of the pedicle has not only been found to be perfectly safe, but there seems no question that the great diminution in the mortality after ovariotomy in recent times is to be ascribed in very great part to this change in treatment. The tumour having been removed, the surgeon passes down his finger to the other ovary to assure himself that it is healthy. If so, the wound is united, after any cyst-fluid which has got into the pelvis has been gently removed with a perfectly clean new sponge. In uniting the wound stout gilt harelip needles used to be much used. These are passed from the left to the right lip of the wound, about an inch from its edge, and embrace the whole tissue down to the peritoneum; and it is well, I think, that the pin should take up a small piece of the peritoneum on either side (p. 214). Sir Spencer Wells, however, prefers sutures of pure silk, each piece of silk being threaded on two needles which are passed in from the peritoneal edges on either side of the wound to the skin. This way of passing the sutures has the advantage that the edges of the wound can be so drawn up with the sutures which have been already passed, that in placing the later ones the surgeon cannot wound the bowels or other viscera—an accident which is known to have taken place with the harelip suture. The wound is then dressed, and a broad flannel roller applied, and the patient cleaned from any stains of the operation, and put into a warmed bed. About $\frac{1}{4}$ of a grain of morphia should be injected subcutaneously, or double the quantity introduced as a suppository.

In cases where there is 'a great probability of blood, serum, or pus collecting in such quantity as to require removal,' Sir Spencer Wells is in favour of drainage of the peritoneal cavity by a glass tube passed behind the uterus to the bottom of Douglas's pouch, and secured in the wound, through which the peritoneal fluid can be removed with a syringe, or antiseptic injections practised ('Med.-Chir. Trans.' vol. lx).

if possible. But much will depend on the sequelæ of a first tapping, which is useful in many ways, and hardly ever causes any bad symptoms. Afterwards, if the tumour refills only slowly, the patient may be better advised in having it tapped repeatedly rather than running the risk of the radical operation. But repeated tapping is by no means devoid of danger, and in cases of young healthy women ovariotomy is on the whole far preferable, and should be performed at once without any preliminary paracentesis.

Ovariotomy.

Ovariotomy is thus performed. The patient should have been well purged, and should have her legs covered with a pair of warm drawers. The room should be warm—nearly 70°. A large band is to be passed round the belly of waterproof cloth, with a hiatus for the incision. She should be in the recumbent position on a firm table. The bladder should be empty. Full anæsthesia having been produced by ether,[1] an incision is made in the linea alba from a little below the umbilicus to a little above the pubes, and this is deepened by successive strokes of the knife till the peritoneum is exposed. The peritoneum having been opened, some ascitic fluid very commonly escapes. The surgeon introduces his fore and middle fingers, and sweeps them round over the cyst to ascertain in the first place that he is really in the peritoneal cavity, and secondly to feel for adhesions.[2] These, if present, are gently separated from the wall of the cyst, until the whole hand is introduced, and the cyst is freed from adhesions on all sides. Now the trocar is plunged into the cyst. To the trocar a tube is fixed which goes into a pail on the floor. As the cyst is punctured the surgeon seizes it with a vulsellum and draws it forward, so as to keep the trocar opening as much as possible outside of the wound in the belly, and he and his assistants take care that the trocar does not slip. Sir Spencer Wells has introduced a trocar the end of which is hollow and can be retracted within the canula, and which has a set of hooks on each side. As the cyst-wall collapses with the escape of the fluid it is drawn into the grasp of the hooks, and thus the canula is firmly fixed. I have used this trocar with good results; but if the cyst wall is thin the hooks are liable to tear it, and then it is better to trust to gentle traction with blunt forceps. As the fluid escapes and the cyst collapses the surgeon passes his hand gently round the sides and top of the tumour to ascertain that there are no adhesions behind, to divide them carefully if there are, and to deliver the cyst. And at this stage of the operation the operator may find reason to extend his incision upwards even as high as the ensiform cartilage.[3] At the same time the assistants (one on each side) keep up guarded pressure on

[1] Sir Spencer Wells uses the bichloride of methylene; but ether seems to have all the necessary properties, being little liable to cause sickness and not producing depression, while it is by most surgeons regarded as safer than methylene.

[2] I know of no way of determining the presence or absence of adhesions in most cases. Sometimes they may be detected by a certain crackling of fluid in them, and may often be suspected from the history of previous pain or other symptoms of peritonitis. But in all old-standing cases they may be expected. Their existence to a moderate extent does not seem to prejudice the patient's prospect. Sir Spencer Wells is in favour of opening and emptying the principal cyst before making any attempt to separate the adhesions, believing that thus there is less risk of mistaking the peritoneum for the cyst-wall. Other operators are in favour of separating the adhesions in front before opening the cyst. Doubtless either the one or the other course has its advantages in appropriate cases.

[3] It is well not to make the incision longer than necessary. It is true that it is far better to make any necessary length of incision than try to remove a large tumour through too small an opening—but Sir S. Wells shows that when the mass can be removed through an incision only 5 or 6 inches long, the mortality is considerably less than when the wound extends to 9, 10, or 11 inches.

either side of the abdomen, so that the intestines may not protrude. When the first cyst has been emptied it may be necessary to puncture others in the same way before the tumour can be delivered, and in doing so the escape of cyst-fluid into the peritoneal cavity is still more probable. Or the tumour may be adherent to the liver or omentum above, to the intestines behind, or to the wall of the abdomen or pelvis. These posterior adhesions are the most formidable complication in ovariotomy, especially those to the intestine. The omentum contains large vessels, and it may be necessary to tie it with catgut before freeing it from the tumour; otherwise there is little trouble in dealing with omental adhesions. Adhesions to solid viscera are not generally very formidable, but the intestine is sometimes almost imbedded in the wall of the tumour. In such a case the peritoneal lining of the tumour must be slowly and carefully peeled off along with the bowel. Clamps of various forms should be at hand, so that any broad band of adhesion may be securely clamped while it is divided and its vessels tied with catgut. This appears preferable to searing the bleeding surface with the actual cautery, though this is a plan adopted with success. Finally, the tumour having been freed and its remains delivered through the wound, its pedicle must be secured. Three ways are in use for this purpose, viz. to fix a clamp on the pedicle, outside the wound, to divide the pedicle with an écraseur, cauterise it if necessary and drop it back into the pelvis, or to tie the pedicle with carbolised silk, cut the ligature short, and remove the tumour. The use of the clamp was at one time almost universal, but it is now I believe entirely given up; nor do I know that anyone, at least in this country, employs the écraseur. The intraperitoneal ligature of the pedicle has not only been found to be perfectly safe, but there seems no question that the great diminution in the mortality after ovariotomy in recent times is to be ascribed in very great part to this change in treatment. The tumour having been removed, the surgeon passes down his finger to the other ovary to assure himself that it is healthy. If so, the wound is united, after any cyst-fluid which has got into the pelvis has been gently removed with a perfectly clean new sponge. In uniting the wound stout gilt harelip needles used to be much used. These are passed from the left to the right lip of the wound, about an inch from its edge, and embrace the whole tissue down to the peritoneum; and it is well, I think, that the pin should take up a small piece of the peritoneum on either side (p. 214). Sir Spencer Wells, however, prefers sutures of pure silk, each piece of silk being threaded on two needles which are passed in from the peritoneal edges on either side of the wound to the skin. This way of passing the sutures has the advantage that the edges of the wound can be so drawn up with the sutures which have been already passed, that in placing the later ones the surgeon cannot wound the bowels or other viscera—an accident which is known to have taken place with the harelip suture. The wound is then dressed, and a broad flannel roller applied, and the patient cleaned from any stains of the operation, and put into a warmed bed. About $\frac{1}{4}$ of a grain of morphia should be injected subcutaneously, or double the quantity introduced as a suppository.

In cases where there is 'a great probability of blood, serum, or pus collecting in such quantity as to require removal,' Sir Spencer Wells is in favour of drainage of the peritoneal cavity by a glass tube passed behind the uterus to the bottom of Douglas's pouch, and secured in the wound, through which the peritoneal fluid can be removed with a syringe, or antiseptic injections practised ('Med.-Chir. Trans.' vol. lx).

The after-treatment of the case should be simple. For about twelve hours nothing should be given by the mouth. The patient, if restless, should be quieted by subcutaneous injections or suppositories of morphia, some pieces of ice should be given to suck, and she may, if much exhausted, require stimulant enemata; but as a general rule the less that is given in any way at first the better. The room should be kept warm but fresh, and the pulse and temperature carefully watched; and as soon as the tendency to vomiting has passed away, nourishment and stimulants should be given as the state of the pulse indicates. The urine must be evacuated with the catheter for several days at any rate after the operation. The wound must be treated on general principles. In favourable cases it will not want touching for about eight days, when it will be found completely united.

Acute and general peritonitis is almost always rapidly fatal. Its treatment must be the same as after herniotomy. Limited inflammation and suppuration sometimes occurs around the pedicle, and by no means precludes the hope of a successful issue, though it will retard union.

Results of ovariotomy.

No operation has been more conspicuously, and I may say more wonderfully, improved in its results by the modern methods of treatment than ovariotomy. Introduced into general practice at a time which is still very recent, it was at first vehemently denounced (and that by some of the best and most experienced surgeons and obstetricians of the day) on account of its hopeless character and excessive mortality. It is now practised with a success far above that of most of the capital operations, as far as its immediate mortality goes, and has the great additional advantage that it leaves the patient unmutilated and unimpaired in function or constitution, with the normal expectation of life; and, if one ovary only has been removed, apparently as fertile as before. This improvement in the results of the operation has been gradual, as may be seen from the interesting paper ('Med.-Chir. Trans.' vol. lxiv.) in which Sir Spencer Wells sums up the results of 1,000 cases of ovariotomy in his own practice from 1859 to 1880. 'The number of deaths in each series of 100 cases, from 34 in the first 100 and 28 in the second, was 23, 22, 20, 28, 24, 17, and 11.' This progressive diminution was due in part no doubt to increased familiarity with the operation, and in great part to the intraperitoneal method of securing the pedicle, which has now become the rule both with Sir S. Wells and all other operators; but in great part also to that minute attention to scrupulous cleanliness which constitutes the antiseptic method. In fact, Sir S. Wells, while allowing the great effect which the intraperitoneal method has had in reducing the mortality, says that the success of this method is only possible provided that putrefactive changes can with certainty be avoided in and about the tied pedicle; and so far as this goes all surgeons are agreed. Whether the special precautions which are comprised under the term 'Listerism' be or be not advisable, is however a question by no means settled, and especially as to the use of the spray. In the volume of the 'Med.-Chir. Trans.' above referred to (vol. lxiv.), are two papers by experienced ovariotomists, Dr. Bantock and Mr. Knowsley Thornton, the former of whom rejects the carbolic spray and all the other special details of Lister's method, trusting merely to the most scrupulous cleanliness; while the latter is an ardent follower of Mr. Lister. Mr. Knowsley Thornton uses all the Listerian precautions, and claims a mortality of four per cent. Mr. Lawson Tait ('Med.-Chir. Trans.' lxiii. p. 161) rejects them all, and claims the same success. Mr. Lawson Tait agrees with Dr. Bantock in thinking that the carbolised spray is deleterious,

Antiseptic ovariotomy.

and in fact it is now seldom used. At St. George's Hospital a spray of sulphurous acid was at first substituted for it; but now cases seem to do equally well without any spray at all. But the precautions against any accidental impurity being brought into contact with the peritoneum, or any putrefying or putrescible matter being left in the peritoneal cavity, must be very thorough. The incision is to be made slowly, and all bleeding vessels to be commanded, either with clamp or carbolised ligature at once, so that no blood runs into the deep parts. In dividing adhesions similar precautions are to be taken. All the instruments and sponges are to be carefully cleaned and then soaked for a proper time in carbolic lotion before use. No sponge which has been used should be used again that day, and every instrument is to be immediately replaced in the lotion. The operator should frequently clean his hands, so as to avoid as far as possible inoculating the parts exposed with any blood or fragments of decomposable matter; and if any cyst-fluid or blood has got into the peritoneal cavity, it should be carefully removed before the wound is sewed up. Whether the dressing should be 'antiseptic' in Lister's sense, i.e. containing carbolic acid or other volatile antiseptic for the destruction of the germs in the air which reaches the wound, is another moot point. Several operators claim as much success with ordinary dry dressings as others do with carbolic and other antiseptic gauze. The wound is united throughout, no drainage being ever thought necessary, except in some rare cases of tendency to oozing of blood, or in cases where some adherent portion of the cyst is necessarily left behind. No second dressing will be required usually till about the eighth day, when the wound will be found united and the patient practically well. In such cases, which are now becoming the rule instead of the exception, there is very little and sometimes no fever, nor any necessity for special treatment.

Another gratifying feature in this improvement in our experience of ovariotomy is that the operation is performed in general hospitals and by the ordinary surgeons of those hospitals with perfect success, and that no special institutions or special operators are required. The patient merely wants a room and a nurse to herself, and to be attended by persons who know how to take the proper precautions and are careful to do so.

Malignant ovarian tumours.

I have spoken of cases of ordinary ovarian tumour in which the surgeon believes the disease to be of a non-malignant nature. When the rapid growth of the mass, and the constitutional condition of the patient excite a suspicion of cancer, it is, as a general rule, advisable to abstain from operating. Yet Sir Spencer Wells has shown[1] that in some cases where the growth seemed undoubtedly malignant, the operation has succeeded, and the patient been, at any rate for 10 or 11 years, free from any return.

The more strictly obstetric operations, viz. the Cæsarian section and those for extra-uterine pregnancy, are not treated of in this work.

[1] 'Brit. Med. Journ.' 1878, vol. i. p. 927.

CHAPTER XLI.

DISEASES OF THE BREAST.

Hypertrophy.

THE female breast is occasionally affected with simple hypertrophy. It is a rare disease which commences generally soon after puberty, in single women as well as married. It is distinguished from tumour of the breast partly by its perfectly even and homogeneous feel, partly by the absence of all symptoms, and partly by the fact that it usually affects both breasts, which tumours hardly ever do. The diagnosis is generally obvious if careful examination be made. In some cases large tumours of the breast have been carelessly classified as 'hypertrophy;' but the error is one easily avoided. Nor should the genuine hypertrophy be confounded with the temporary enlargement which sometimes accompanies amenorrhœa. The differences are well described by Mr. Birkett.

When the breasts are seen to be enlarging gradually, and to an inconvenient extent, the surgeon's first care is to inquire into the general health, and to attempt to stop the progress of the affection by correcting anything that may be amiss. Carefully applied pressure may also be tried. But it must be allowed that little good is usually done by any measure short of amputation, and to this no surgeon would willingly resort unless it is absolutely necessary in order to allow the patient to go about. It is said that sometimes after the removal of one breast, the other has become smaller.

Atrophy.

Atrophy of the breast is natural in the later period of life, though usually it is not much noticed, as the place of the gland-tissue is occupied by fat; but atrophy also takes place sometimes without any known cause, or in connection with the growth of a tumour in some part of the breast, or from excessive lactation. But it must be remembered that a good deal of wasting of the breast is quite consistent with the perfect integrity of the gland-tissue as evidenced by the secretion; and it is noticed that women with breasts which are very small, and have been supposed to be atrophied, often have a fuller supply of milk than others. Sometimes, however, there is genuine atrophy with consequent want of milk. Nothing can be done to avert it.

Inflammation.

Inflammation of the rudimentary breast in infancy is not uncommon in both sexes, perhaps more so in boys than girls. It produces redness and tenderness, with a serous or even milky secretion from the nipple. Nurses are in the habit of aggravating the mischief by rubbing, to 'rub away the milk,' as they phrase it. This ought never to be permitted; the irritation will soon subside under soothing lotions and cataplasms, with attention to the state of the bowels.

Inflammation also occurs sometimes at puberty, and here also in the male as well as the female; though in boys it is usually insignificant and transient.

Chronic abscess.

In females it sometimes lays the foundation of chronic abscess, an affection often mistaken for tumour; and, in fact, not easy to distinguish from a solid tumour by palpation. But in all cases where a perfectly healthy young woman presents a rounded elastic lump in the breast, the idea of chronic abscess should occur to the surgeon's mind, and he should be cautious of giving an

opinion without an exploratory puncture. I have seen several such cases brought into operating theatres, a mistake which indeed involves no bad consequences, since the abscess is opened by the incision made to expose the supposed tumour; but which, at any rate, involves unnecessary alarm to the patient, and is as well avoided.

I have heard of breasts having been removed for chronic abscess, a grave and a disgraceful mistake.

Lacteal abscess.

The common cause of inflammation of the breast is irritation in suckling, and usually in women who persist in doing so when in too weak a condition to bear it. Its cause is often to be found in an imperfect development of the nipple. The woman is generally a primipara, and the abscess usually occurs within about a month after delivery. But the inflammation sometimes commences with the secretion of the milk or even before this, with the vascular excitement preliminary to the secretion, especially if the breast has been irritated or injured. Abscess soon forms, sometimes with much fever and constitutional disturbance. The abscess presents in one of three situations; over the breast, in it, or behind it. Superficial abscess produces generally only slight symptoms; the pus lies near the surface, and a simple puncture suffices for its evacuation. The true mammary abscess is usually accompanied by more fever than superficial abscess, and by much tension, heat, and pain in the breast. As soon as fluctuation can be felt, or even before, if the symptoms be decided, a free incision should be made into it, in a direction radiating from the nipple. The evacuation of the matter gives great relief, and prevents the abscess from burrowing about in the gland or behind it. Cases in which incisions have been neglected or refused are often seen, in which the breast is riddled with sinuses, indurated in various parts, and probably permanently damaged as a secreting organ. In the deep or submammary abscess the whole gland is raised from the surface of the chest, and floats on the subjacent matter as on a water bath. In this form, the patient should be brought under anæsthesia, and an incision made under the breast into the collection of matter, so as to afford a depending opening, which is to be kept patent with oiled lint. Or it is sometimes useful to pass a drainage-tube. It saves subsequent cutting to make a satisfactory opening at first, or even to open the abscess in several places.

Patients with abscess after lactation should give up suckling entirely; they require good diet, full doses of quinine are often very beneficial, and a moderate allowance of wine or porter; care being taken not to overload the digestive organs.

Precautionary measures may sometimes avert abscess in parturient or pregnant women whose breasts are much congested with milk, or in whom the large milk-ducts are obstructed. These consist in free purging, soothing warm applications to the breast, drawing off the superfluous milk with a pump, and opening any ducts which are found to be obstructed with epithelium. The careful application of pressure also, by methodical and evenly applied strapping, may succeed in averting the formation of abscess, if used at a sufficiently early period when the patient can tolerate it.[1]

Lobular induration.

Hyperæsthesia of the breast, with chronic induration of various parts of it, is extremely common, and is very liable to be mistaken for tumour. In some cases the whole breast remains, after an acute attack of inflammation, hard, heavy, and somewhat tender. These cases are not so difficult of diag-

[1] See a quotation in the 'Medical Press and Circular,' Jan. 26, 1876, from a paper by Dr. Munson in the 'New York Med. Journ.'

nosis, but when only a portion of the breast is indurated the hardened part much resembles a scirrhous or glandular tumour. The diagnosis can only be made by the fact that various separate lobules are usually affected and often in both breasts, and by the general aspect of the case, and of the patient, to which Mr. Birkett adds as diagnostic signs that in these cases the pain usually follows the course and distribution of one or more nerves, and that if these nerves be sought for and pressed upon as they issue from the thorax, the slightest pressure will induce acute pain, sometimes confined to a single branch distributed to the indurated part while the rest are unaffected. This induced pain is, he says, almost pathognomonic of the disease. Another diagnostic sign on which he also lays stress is, that 'when the hand is pressed gently over the gland, nothing indicating the existence of a new growth is felt, which always happens when one exists—the induration is very distinct if compressed between the fingers and thumb, but imperceptible with the hand placed flatly on the part.'

In treating this affection the first point is to improve the general health, to insist on healthy habits of exercise, to cure any menstrual irregularities, and to dissipate the apprehensions of tumour and cancer which the patient probably entertains. Quinine, iron, and mineral acids often do good if the digestion be attended to, and iodine internally is highly thought of by some surgeons. Local applications are always useful in removing the part from the patient's own constant inspection and handling, for which purpose a belladonna plaster may be used; the breast if heavy and pendulous must be supported from the opposite shoulder. In some cases, where pressure can be tolerated, strapping, applied over a layer of mercurial ointment, removes the induration. Where the evidences of inflammation are more distinct, evaporating and soothing lotions must be employed.

Neuralgia, or hysterical pain.

In other cases, even without any swelling or induration, the breast is the seat of almost intolerable pain, sometimes constant, sometimes periodic, and usually accompanied by hyperæsthesia of the skin of the breast, as well as by pain in the neighbouring parts. The affection is more common in young girls than in elderly persons, and in the unmarried than the married. It is usually associated with deranged menstruation, and probably with other disorders of health and digestion; and those who suffer from it may sometimes be found to be addicted to depraved practices. The treatment consists in protecting the breast from all contact or examination. The organ will often be found to be hard, prominent, and congested; and in this condition, I believe, relief will often be obtained by tolerably firm strapping, which may be applied under anæsthesia if necessary. The bowels and the state of the menstrual secretion must be carefully attended to, and the moral treatment recommended for other nervous disorders must be strictly enforced, and it is unnecessary to say that any secret practices which may be detected must be put a stop to.

Functional disorders.

The secretion of milk may be disordered in various ways. It is said that in rare cases the breasts have been known to secrete milk quite independent of pregnancy; in old women, children, and virgins. Atrophy of the breast-tissue, causing absence of the secretion, has been referred to above. The opposite state, in which the secretion is excessive (galactorrhœa), or in which it does not cease on the cessation of suckling, is connected with derangement of the general health, and will subside as this is restored. The only derangement of secretion which constitutes a specific disease is congestion with milk, which sometimes leads to so much solidity and brawniness of the organ as to

be taken for cancer, especially as the raising of the gland causes the nipple to be buried. The diagnosis is settled by observing that there was no tumour before delivery, and that cancer hardly ever begins during suckling. Abscess is to be apprehended, yet cases occur, according to Mr. Birkett, in which the congestion subsides and the breast is again quite useful. Only one breast is usually affected. The improvement of the general health, weaning the child, pressure with carefully applied strapping, or the application of tincture of iodine, or iodide of lead ointment, are the measures prescribed for the treatment of this condition.

Tumours of the breast.

Adenoma.

The disease described by Sir A. Cooper as 'chronic mammary tumour,' and formerly regarded as a fibrous growth, is now usually denominated by some name such as Adenoma, Adenosarcoma, Adenoid tumour, or Mammary glandular tumour, in order to mark the fact that in its structure tissue is found which bears considerable resemblance to that of the gland itself. Simple adenoma forms a firm, lobulated tumour, surrounded by a capsule of fibrous tissue, in which, on microscopic examination, rudimentary breast-tissue is found, i.e. the cæcal pouches in which the ducts commence, and in some cases, according to Mr. Birkett, rudiments of the ducts themselves. He also describes tumours in which 'the observer may detect ducts, sinuses, and even the secretion peculiar to this gland.'

Adenoma is more common at an early period of adult life, the decade from twenty to thirty years of age forming the majority, and it commences more commonly in single than in married life.

Serocystic tumour.

Closely connected with this disease is the form of new growth described by Sir B. Brodie as *serocystic*, and by Mr. Cæsar Hawkins as *tuberocystic* tumour. In this disease cysts are found into each of which a new growth projects. The cysts contain a tenacious viscid fluid, often more or less dark in colour from the admixture of some of the elements of the blood. Very commonly there are many such cysts, and the growth of the solid matter into them gradually fills them up, until at length they are almost altogether obliterated; and then the growth projects through the cyst, presses on the skin, bursts it and fungates. Two views prevail of the origin of these growths. In Sir B. Brodie's view the cyst was the original formation, being produced either by the obstruction of one of the ducts of the gland (which, however, seems to be very rare), or in the connective tissue of the part, in the same way as cysts form in any other part of the body. The solid tumour then grows from the tissue which forms the wall of the cyst. But in Mr. Birkett's view the so-called cyst in these compound tumours is a secondary formation, and is really only a space in the capsule of the tumour, the layers of which are separated by fluid which has accumulated probably in consequence of the pressure of the solid growth below it. Mr. Birkett, therefore, describes serocystic or tuberocystic tumour as merely a variety of the adenoid tumour; and he separates the cystoid cavities which form parts of such tumours entirely from the true cysts, likening them rather to 'the arrangement of the capsular ligaments of joints attached around the articular ends of the long bones than to genuine cysts.' The solid matter which forms the growing portion of such tumours consists in large proportion of cells, usually spindle or awn-shaped, and rapidly growing into imperfect fibrous tissue, constituting the 'fibro-plastic tumour' of Lebert, or the 'spindle-celled sarcoma' of later pathologists. The imperfect imitation of the gland-tissue characteristic of adenoma is also often met with in portions of these tumours, and this fact,

together with the occasional co-existence of the firm adenoma (or chronic mammary tumour) with such serocystic growths, of which an excellent drawing will be found in Mr. Birkett's essay ('Syst. of Surg.' 3rd ed. vol. iii. p. 443), has led him to classify the serocystic tumour as a variety of adenoma.

Operations for adenoma and serocystic tumour.

At the same time, even if we allow that the two are varieties of the same form of tumour, they are varieties which are characterised by the very important difference that in the firm, hard, lobulated tumour which Sir A. Cooper described as chronic mammary, in which there are no cysts, in which the fibrous tissue forming the framework of the adenoid growth is well developed, and the whole mass free from juice, recurrence after removal hardly ever takes place; nor is it necessary to remove more than the tumour itself. A free incision having been made through the capsule of the new growth, the latter should be enucleated, the breast being preserved, and especial care being taken not to interfere with the nipple or the large ducts converging to it, particularly if the patient is likely to have children. She may then be confidently assured that no recurrence is probable.

But in the serocystic tumours, when the fibro-plastic or sarcomatous element prevails in the solid growth, the case must always be looked upon with apprehension; for such tumours do unquestionably recur, and they are the more prone to do so the more succulent, loose, and imperfect their tissue is, and perhaps the older the patient is at the time of their formation. This recurrence takes place generally only in the scar itself, and I have seen several cases in which the patient has preserved her general health entirely unaffected after the disease had recurred many times. In one remarkable case in Mr. Cæsar Hawkins's practice at St. George's Hospital, it was not till after ten recurrences and eighteen years' duration of the case that the patient finally succumbed to exhaustion produced by the sloughing of the tumour, which at length it became impracticable to extirpate. But I have known one instance in which a serocystic tumour recurred in the other breast. These circumstances should teach caution in prognosis, and should incline the surgeon rather to remove the whole breast than merely extirpate the tumour whenever the growth is large and advancing rapidly, and particularly if the patient be somewhat advanced in years, or be from any cause unlikely to suckle.

Diagnosis.

The diagnosis between simple adenoma and lobular induration has been given under the latter head. From cancer there is usually no difficulty in distinguishing it, if the case be kept for some time under observation, looking to the age of the patient, the non-implication of the axillary glands or of the skin, the absence of the stabbing pain of cancer, the more lobulated feeling and less firm consistence of the tumour, and the almost imperceptible progress of the disease, though an incipient cancer is not uncommonly mistaken for adenoma on a single examination. The diagnosis between the serocystic tumours and the softer forms of cancer is sometimes by no means easy; for even if the presence of cysts has been ascertained, such cysts may exist in a mass of medullary cancer. But the rate of growth of the two diseases is very different—the skin is unaffected in the serocystic tumour, or if adherent is not infiltrated and brawny as in cancer; nor are there the large superficial veins, and the great general vascularity which is found in cancer. However, if the growth be advancing rapidly, it is better to pronounce a very guarded diagnosis before removal, and to insist on the necessity of extirpating the whole breast; and when the skin has given way and the tumour is fungating out of a large opening, the diagnosis is the more difficult, and the removal of the entire breast more obviously necessary. The condition

of the surrounding skin is the chief element in diagnosis during this stage of a serocystic tumour. The edges of the ulcer are sharp-cut, and the neighbouring skin thinned; while in the cancerous ulcer the edges are prominent and hard, and the cancerous matter is infiltrated for some distance around.

Simple cysts also occur in the breast, in which no solid growth ever takes place. Some depend on obstruction of the ducts of the gland and contain a tenacious mucoid fluid. Such obstructed ducts forming small cysts will very often be found, on careful examination of the breasts of women who have borne children, and in whom the cysts have remained so small as never to occasion any symptoms. At other times, oftener in those who have borne children, one or more of them increase till they project under the skin and attract the patient's attention. Other cysts, also, sometimes form in the neighbourhood of the nipple, usually earlier in life than the duct-cysts, and in women who have not borne children, containing a simple watery serum, with only a slight proportion of albumen. These simple cysts require only a puncture, with pressure or stimulating lotion afterwards. The puncture may be repeated if the cyst fills again, or it may be laid open and made to granulate. Sometimes the tumour bursts of itself, and then usually disappears. Simple cysts.

Milk-cysts, or 'galactoceles,' are tumours which form during lactation, either from mere dilatation of an obstructed duct, or from its rupture and effusion of the milk into the neighbouring tissue. They may subside on the cessation of suckling, to recur at each of the following pregnancies, of which Mr. Birkett gives a remarkable instance; and as the contents thicken they may present a considerable resemblance to a solid tumour. The cases are rare and the diagnosis will be difficult unless the patient has been under observation, and the sudden development of the tumour during suckling has been noticed. Generally they are not diagnosed till after a puncture has been made, when the cyst must be emptied and made to heal by granulation. Milk-cysts.

Innocent tumours of other forms are met with, though very rarely, in the female breast. The expression 'hydatid disease' in the older authors usually means cystic or serocystic tumour; but echinococci are sometimes found in laying open what have been taken for common cysts or abscesses. Common fibrous or fibro-cellular tumours are also found, but can hardly be diagnosed before removal. Fatty tumour may of course form in the adipose tissue over the breast, though I cannot remember to have seen a case; and a few cases of enchondroma are on record. Rarer forms of tumour.

The main point in these cases is to distinguish them from cancer, in order to preserve the breast if possible. The precise anatomical form of the tumour is generally only ascertained after removal.

Scirrhus is the form of cancer most commonly met with in the female breast, though medullary or soft cancer is not very uncommon. Isolated examples of colloid are to be found here and there, and have been known to run a definitely malignant course: but the nature of the disease can hardly be diagnosed before removal, nor is the prognosis by any means certain. As usually seen, cancer of the breast presents itself as a small, hard, stony lump situated in the thickness of the gland, and the size of the breast is noticed not to be much increased, even as the tumour enlarges, since the tissues around shrink as they become adherent to the tumour. This same shrinking of the tissues and the adhesion of the cellular tissue to the tumour produce the dimpling of the skin and the retraction of the nipple which are so often seen in cancer. The adhesion, however, may take place in the other direction, causing Cancer.

the tumour to become attached to the pectoral muscle, or even to the ribs. Later on the cancer infiltrates the skin, and then ulcerates, fungating out of the ulcer in large bleeding masses if it be of the soft kind, or else producing the scirrhous ulcer. Cancer of the breast is accompanied by lancinating pain in the chest and neck and down the arm, by wasting and ultimately by cancerous cachexia. The axillary glands become enlarged, and sometimes also the subclavian and other cervical, or even the mediastinal glands. The arm often becomes œdematous from the pressure of these enlarged glands on the veins; and in some cases the skin becomes extensively infiltrated and matted to the deeper parts—'hidebound cancer.'

Cancer in the breast appears either in the form of a defined mass separated from the gland by a distinct capsule, or infiltrated throughout the gland-tissue, or containing cysts which may be formed by the softening of its texture, and according to Mr. Birkett by the effusion of the juices of the cancer into the envelope of the tumour. It occurs usually between the ages of thirty and fifty. Out of 458 cases tabulated by Mr. Birkett, 100 occurred in the decade between thirty and forty, and 198 between forty and fifty. This shows that the occurrence of the disease is relatively most common towards the period of the cessation of the catamenia; yet in examining the particulars of 100 cases, Mr. Birkett failed to detect any connection between the two events, and he equally failed to prove the correctness of the common opinion that cancer is more frequent in the single than the married, and in the sterile than in those who have borne children; or any connection between the growth of cancer and imperfection in suckling. It is noticed that cancer hardly ever begins during pregnancy or suckling, though it is not rare to see cancer in a suckling woman, the disease having begun before pregnancy.

Diagnosis.

The diagnosis of cancer from innocent tumour rests on the more advanced age of the patient, on the hardness of the tumour in scirrhus, its rapid growth and great vascularity in the soft form of cancer, the early implication of the skin and cellular tissue around, leading to dimpling and retraction of the nipple,[1] the affection of the glands, the state of the general health, the characteristic pain (which, however, like pain of all other kinds is liable to be simulated by mere nervous affection), and, lastly, by the occasional deposit of cancer in remoter organs.

Question of operation.

When the diagnosis has been made the question of the removal of the disease has to be discussed. There is not, I think, any convincing evidence either way as to whether the operation prolongs life, or shortens it, on the average of a large number of cases, but I do not see that this tells conclusively either for or against the operation. The operation frees the patient for a time from the oppression of a disease which is known to be gradually advancing to a fatal issue; it renders the interval (allowing that the cancer recurs) one of complete health for the greater part of the time, instead of being a period of pain and anxiety; it gives the patient a chance, however slender, of immunity from recurrence, and in many cases the cancer recurring in an internal organ, such as the liver, terminates life in a less painful manner than by the spread and ulceration of an external tumour. The operation, in these days of anæsthesia and of rapid healing of wounds, is not one of much danger or suffering.

[1] Retraction of the nipple, though far more common in scirrhus, is met with occasionally in non-cancerous tumours, from adhesion of the cellular tissue of the nipple to some portion of the tumour which becomes buried by the growth of neighbouring portions, so that the nipple remains in the pit formed by the growing tumour.

The contraindications to the removal of the breast for cancer are either absolute or partial. The spreading of the cancer so far into the skin or neighbouring parts that the surgeon cannot operate through healthy tissue, the implication of the glands beyond the axilla (in the subclavian triangle, or higher in the neck), the deposition of cancer in other parts, or an advanced condition of cancerous cachexia, are absolute contraindications. The infiltration of the skin to any extent, however small, the ulceration of the tumour, or any implication of the axillary glands, are very unfavourable conditions, though under certain circumstances the surgeon may be justified in operating. It is true that all the visibly diseased skin may be removed with the breast; that the removal of an ulcerated and bleeding mass may produce great temporary relief; and that all the visibly enlarged axillary glands may possibly be excised. The latter point, however, is always doubtful, and the surgeon will often discover when he opens the axilla, expecting only to find one or two small scirrhous glands, that in reality the whole chain of glands is implicated, and that he is committed to a deep and dangerous dissection, which possibly has ultimately to be abandoned without the whole of the diseased glands having been removed. But, however complete the apparent removal may have been, a speedy return of the disease in the cicatrix may always be prognosticated under the conditions specified, so that the operation must under such circumstances at the best be regarded as only a palliative.

Repetition of operation.

With regard to the repetition of an operation, the same considerations exactly apply. Under circumstances which would have justified the original operation it may be repeated, and even more than once, in the cicatrix.

Use of caustics.

That cancerous breasts may be successfully removed by caustics is amply proved by experience. The method is much inferior to removal by the knife, being slower, more painful, and less certain to expose healthy tissue; but the fear of a cutting operation renders the alternative acceptable to many, and the cancer-curing quacks make a livelihood chiefly by concealing some of the common potential cauteries—generally chloride of zinc—with some inert nostrum. On the whole, the chloride of zinc is the best of these caustics, and is, I think, best used on the method of Maisonneuve, 'cauterisation en flèches,' which will be found described in chap. xliv. The method introduced by Fell, of destroying the skin by means of some strong acid, then scoring the exposed surface and stuffing the incisions with the chloride of zinc paste, saves some time and pain.

Treatment of ulcerated cancer.

It is, however, in the treatment of cancerous ulceration that the application of caustics is most frequently advisable. When the ulcer is of limited extent the caustic often gives little pain, and the separation of the eschar is sometimes followed by temporary cicatrisation. Otherwise nothing can be done in ulcerated cancer, except to keep the part as free from odour as possible with some of the tarry solutions, and to soothe pain with morphia. I have found nothing better than the carbolic lotion covered with carded oakum. But the patient may get tired of the odour of this dressing, and then solution of chloride of zinc, or Condy's lotion, or solution of terchloride of carbon or chlorate of potash may be used, mixed with laudanum or belladonna. The balsam of Gurjon, recently introduced, and the boracic acid lately recommended by Prof. Lister for its deodorising qualities have not answered in the trials I have made of them.

Removal of the mamma.

In amputating the mamma it is always advisable, whenever it can be done consistently with removing the whole disease, to leave sufficient skin to cover the wound without any tension. The nipple should be included between two

curvilinear incisions, which are generally made to lie above and below it, though this is a matter almost of indifference. The angle of junction of the incisions outwards can easily be prolonged into the axilla, if any glands are to be removed from thence, and this is better than to make a separate small incision over the glands themselves. The lower flap is to be first dissected back, down to the base of the tumour or of the breast, then the upper, these flaps being made as thick as is consistent with keeping well away from the disease. The breast being now fully exposed is to be forcibly drawn away from the pectoral muscle, and the cellular tissue which unites them divided by rapid strokes of the knife, the assistant putting his fingers on the bleeding vessels, which should then be rapidly secured with carbolised catgut ligatures. When all bleeding has been thus commanded, the wound is to be united by sutures, and dressed according to any plan which the surgeon prefers as likely to procure speedy union. Very often a large part, and in some rare cases the whole, of the wound unites by primary union.

Diseases of the mammilla.

Malformations are common in the nipple. It is sometimes bifid, sometimes multiple, far more often deficient or ill-developed, and such ill-developed nipples are fruitful causes of trouble in suckling, as pointed out above. It may be possible, in some cases, where the nipple is merely short but otherwise natural, to draw it out by constant well-directed pressure by means of a breast-pump, and the attempt is worth making in a married women before she becomes pregnant, or during pregnancy. Inflammation of the nipples and small ulcers or cracks on them are very common, especially during a first suckling. The ulcers should be carefully cleaned, covered with fine powder, as oxide of zinc, dusted on them through a muslin bag; or coated with collodion, and protected by a shield from direct contact with the infant's mouth. When abscess forms near the nipple it should be allowed to burst, or at least to come close to the surface, for fear that in opening it the milk-sinus should be wounded.

The nipple and areola are occasionally found to be the seat of epithelioma. I once treated a case of this kind in a married lady, who from some malformation had (as I was informed) never been capable of complete sexual intercourse. The nature of the disease was indubitable, and was proved afterwards by microscopic examination. There was a small hard gland in the axilla, which was not removed; but the nipple and areola were fully excised. I saw her five years afterwards in perfect health, and the gland had quite disappeared. Such a case, however, should be carefully watched; and on the appearance of any recurrence and extension of disease to the breast the whole organ should be removed.

Sir J. Paget has lately called attention [1] to the frequency with which an obstinate eruption of the nipple and areola, resembling eczema or psoriasis, is the precursor of cancer in the mammary gland. The eruption is very rebellious to treatment, and usually persists till the period at which the cancer appears. He has noticed fifteen cases, in all of which the cancer showed itself within two, and in most within one year after the eruption. The cancer is not continuous with the diseased nipple, but grows in a remote part of the gland. In such cases, particularly when cancer is known to have existed in the patient's family, he believes the diseased skin ought to be removed or destroyed.

The nipple is sometimes the seat of common sebaceous or cystic tumours

[1] 'St. Bartholomew's Hosp. Reports,' vol. x. p. 87.

and of nævi, but their treatment is the same as in other regions. Great care, however, must be taken not to induce deformity by any operative measures undertaken for their cure.

Diseases of male breast.

Analogous affections sometimes, though rarely, attack the male breast. The irritation which in male infants sometimes leads to a secretion of milk has been spoken of. In later life tumours form in the male breast which are usually of a scirrhous nature, sometimes fibrous, and I have once seen a case of serocystic tumour, precisely like the same disease in the female.[1] The disease occurred in a man aged 54. The diagnosis of these affections is much the same in the male breast as in the female. Any growth which forms in this situation should be at once removed.

[1] St. George's Hospital Museum, Ser. xv. No. 50.

CHAPTER XLII.

DISEASES OF THE THYROID BODY.

Endemic goitre.

THE thyroid gland is liable to an endemic enlargement, which is called goitre, and which prevails extensively in the valleys of many mountain regions in various parts of the globe, from some cause which is not completely understood. Cretinism also prevails usually in the same locality, either in the same or different persons. In this country the endemic form of bronchocele is known as 'Derbyshire neck,' from the place where it chiefly prevails. This endemic disease seems susceptible of little alleviation, either from prophylaxis or treatment, nor can it be till its cause has been discovered.

Sporadic or common bronchocele.

More important in practical surgery, though far less so in public hygiene, are the sporadic cases of bronchocele which are seen pretty commonly in all parts of the country. Most of the patients are females, and usually unmarried. There is very commonly some menstrual irregularity; yet the general health is often perfectly good. The disease consists in an enlargement of one or both sides of the thyroid body along with its isthmus, the enlargement being generally most marked on the right side. Sometimes it extends behind the sternum. It often causes distressing dyspnœa from pressure on the trachea, and has been known to produce death from this cause.[1] Sometimes, also, it seems to cause loss of voice from pressure on the recurrent laryngeal nerves, or even spasm of the glottis from irritation of the same nerve, and I have known a case where the tumour burst, and suppuration threatened to prove fatal. The structure of the tumour usually consists of one or more large cysts, surrounded by the hypertrophied gland-structure, or it may be entirely solid (fibrous bronchocele).

The treatment of the disease which is most relied upon is by the external and internal use of iodine, due attention being given to the general health, and especially the menstrual functions. Dr. Morell Mackenzie has[2] called attention to the benefit which may be produced in cystic bronchocele by the injection of perchloride of iron. His plan is to tap the cyst, then to inject ʒi. or ʒij. (according to the size of the cyst) of a solution of perchloride of iron (ʒij.: ℥i.) which is left in the cyst for about three days, the canula being plugged and retained, when the iron is allowed to escape, and the part is poulticed, the plug being still retained until suppuration is fairly established, when it may be removed. I have followed his directions with much success in a case of very large thyroid cyst. In fibrocystic bronchoceles after the cysts have been thus obliterated the solid part is treated by subcutaneous injection of iodine, but this is undeniably dangerous. These cysts are often treated by seton, a practice which, though it is sometimes very successful, is not without its dangers. Latterly the injection of thyroid tumours with ergotine, or with the fluid extract of ergot, has been tried, and I have treated a few cases in this way, but hitherto with no decisive benefit.

Removal of bronchocele.

In some cases it seems to me justifiable to remove such tumours, i.e. either where they threaten to prove fatal by great and increasing pressure on the

[1] See a case related by Dr. Dickinson, 'Path. Trans.' vol. xii. p. 229.

[2] 'Clin. Soc. Trans.' vol. vii. p. 115.

windpipe or other structures in the neck, or when as in my case (recorded in the 'Amer. Journ. of Med. Sci.' Jan. 1873) the tumour has burst, and the suppuration is exhausting the patient. The operation is a formidable one, but has often been performed with success.[1] In cases where the tumour is so very large as it was in the one which I operated upon (where it hung down below the mamma) flaps must be carefully dissected off it, and its base must be commanded by an écraseur, or some form of clamp, while the mass is removed. In smaller tumours, the best plan seems to be to lay open the capsule freely and enucleate the mass with the fingers as rapidly as possible, without paying any attention to the bleeding till the tumour is removed. Dr. P. H. Watson has called attention to the advisability of securing the vessels which nourish the tumour before laying open its capsule or attempting its removal. They can usually be felt pulsating deep down at its lower angles, when an aneurism needle should be passed beneath them; or if the individual vessels cannot be isolated, the base of the tumour may be transfixed and tied in a mass.

Exophthalmic goitre.

A singular malady affects the thyroid body amongst other parts, which is generally called exophthalmic bronchocele, from the protrusion of the eyes, which is one of the prominent symptoms. There is palpitation of the heart, great rapidity of the pulse, extreme prominence of the eyes, and a large soft pulsating swelling of the thyroid body, in which a musical bruit can often be heard, and which varies greatly in size. Another prominent symptom is the jerking pulse in the carotid arteries. In one unfortunate case I saw both corneæ slough and the eyeballs wither away in consequence of their continued exposure. This form of bronchocele is sometimes accompanied by organic disease of the heart; otherwise it is not very dangerous to life, and under proper treatment there is a good chance of recovery. It often depends in some measure on mental causes, and is frequently associated with irregular menstruation. All concomitant circumstances of this kind being ascertained and treated as best may be, digitalis and iron seem to be the most promising internal remedies, and ice to the thyroid tumour the best local application. The reader is referred to works on Medicine for a fuller account of this affection, which falls more commonly under the physican's care.

Cancer of the thyroid body.

Cancer occurs in the thyroid body; but it is very rare. Mr. Haward[2] refers, however, to a few cases recorded by Mr. Cæsar Hawkins and other authors; but the disease is not within the range of surgical treatment.

[1] See especially a paper by Dr. Greene of Portland, Maine, in the 'Am. Journ. Med. Sci.' Jan. 1871. Dr. P. H. Watson ('Brit. Med. Journ.' Sept. 25, 1875) relates the history of six cases, with only one death. Billroth ('Clin. Surgery, New. Syd. Soc. Trans.' p. 162) refers to ten cases, of which only four recovered. A very interesting pamphlet on this subject has lately been published by M. Riverdin (extracted from the 'Revue Médicale de la Suisse Romande,' April 15, 1883), containing the history of 22 operations, only two of which proved fatal, and very valuable data as to their after-progress, and as to the indications for and method of operating.

[2] 'Syst. of Surg.' 3rd ed. vol. iii. p. 596.

CHAPTER XLIII.

DISEASES OF THE SKIN AND ITS APPENDAGES.

It seems necessary to give in this work a general idea of the diseases of the skin, although the subject is so extensive, and the practical considerations connected with the treatment of skin-diseases are so very numerous and complicated, that it is quite impossible for me to attempt anything here beyond the barest outline, and this chiefly with the view of rendering what has been said in previous pages intelligible. But in order to acquire a useful knowledge of the matter and to be able readily to distinguish the various eruptions from each other, it is absolutely necessary to study these diseases in the living body, comparing the eruptions seen in the out-patient rooms or in the wards with the drawings and descriptions which are given in approved authors, and with the models to be found in the Museum of the College of Surgeons and elsewhere.

Affections of the cutaneous system are divided into those of the skin itself, and those of its appendages, the hair, nails, and cellular tissue. We will speak first of the eruptions of the skin itself.

The anatomical classification of these eruptions is the most obvious and the most useful in practice—viz. into 1. Exanthemata, or rashes; 2. Hæmorrhages; 3. Vesicles; 4. Blebs; 5. Pustules; 6. Papules; 7. Scales; 8. Tubercles; 9. Stains; and 10. Parasites—to which certain conditions are to be added, named 'Xerodermata,' resulting from unnatural dryness of the skin.

Exanthemata, or rashes.

Exanthemata—or rashes—are eruptions characterised by the occurrence of patches of skin which are injected and red, and thickened in consequence of being injected, but in which there is not necessarily any inflammatory effusion. The epidermis usually desquamates on the subsidence of an exanthematous eruption.

The skin-eruptions which are properly classed as exanthemata are roseola and erythema. Urticaria so closely resembles some varieties of erythema that it is usually described along with it, though it is not truly an exanthem. Many fevers are accompanied by exanthematous eruptions; but they are not spoken of here, since in them the eruption is only a subordinate symptom.

I have enumerated and described the varieties of erythema in a previous chapter (pp. 39, 40) in connection with erysipelas, so that the only true exanthematous disease left for description here is roseola.

Roseola.

This arises from various causes, but is always of constitutional origin.[1] It is characterised by small rose-coloured spots or a roseate mottling of the skin. Some of its varieties (R. infantilis and R. æstiva) approach very nearly in character to the eruption of measles, and are accompanied by some fever and sore-throat, but are not marked by the coryza of measles. These varieties sometimes bear the name of 'morbilli nothi'—bastard measles.

[1] 'The eruptions proper to typhus fever, measles, German measles, typhoid fever, scarlet fever, and cholera are in reality roseola.'—Bristowe.

Another form of roseola is that which sometimes precedes the small-pox eruption, and occasionally that of cow-pox. Roseola also is found in gout and rheumatism. Another form of roseola is found in definite rings—roseola annulata—hardly to be distinguished from erythema marginatum. This is merely a symptom of deranged digestion. In fact, all these varieties of roseola are in themselves insignificant, although the constitutional condition on which they depend may be of the gravest possible import. The varieties of roseola which constitute substantive diseases require only attention to the state of the digestive organs, and in infancy to that of the dentition, with moderate purging and free action of the skin.

Syphilitic roseola.

In young persons, especially girls, suffering for the first time from syphilis, an eruption is constantly seen which is classed by many under the name of roseola, less red in colour than the non-syphilitic varieties of the disease, and nearly allied to pityriasis. Like the latter eruption its favourite seat is the chest. It will rapidly disappear under the endermic use of mercury.

Urticaria.

Urticaria, or nettle-rash, is usually described along with the exanthemata, though not properly belonging to that class; since in urticaria there is not only redness fading on pressure, as in the exanthematous eruptions, but also elevated flat patches of skin called wheals or 'pomphi.' These wheals are seated on the red patch of skin, and they testify to the effusion of serum into the tissue of the cutis, just as the wheals which occur in insect-bites do, and as the wheals which follow a lash testify to effusion into the substance of the skin. These wheals tingle and burn like the stings of nettles. Urticaria is excited by all sorts of causes which disturb digestion; errors in diet, especially the eating of shell-fish by those with whom it acts as a kind of poison, or from local irritation of the skin. These kinds of urticaria are acute and transitory, and can be cured by the withdrawal of their causes, an emetic if needful, and a mercurial purge. There are other varieties of urticaria which are chronic. In some of these the individual wheals disappear while others come out—U. evanida; in others, on the contrary, they are persistent —U. perstans; other minuter differences in the arrangement and size of the wheals are expressed by the terms U. conferta, U. tuberosa; and a kind in which the causes and the symptoms of urticaria are present, the burning, tingling, &c., but no wheals are seen, is called U. subcutanea. In these more obstinate cases of urticaria the first care is to soothe the irritation of the skin by some wash. Lemon-juice or vinegar often succeed. Sir Erasmus Wilson prescribes hydr. perchlor. gr. v–x., sp. roris marini, sp. vin. tenuior. āā, ʒj. emuls. amygdal. amar. ʒvj. A dilute solution of prussic acid and almond emulsion is often very grateful. The next point is to discover and correct any error in diet or regimen, and to try the effect of copious diaphoresis, combined with change of air, active exercise, and sea-bathing. In other cases, arsenic, quinine, colchicum, or alkaline medicines have acted beneficially.

Hæmorrhagia. Purpura. Scorbutus.

The hæmorrhagic diseases of the skin are purpura and scurvy. Purpura is characterised by spots (petechiæ) or large patches (vibices) of ecchymosis under the skin, which are easily distinguished from every other form of spot by their persistence under pressure, and by their changing colour with time, as bruises do. Purpura hæmorrhagica is a severer form of the disease, in which blood exudes from the mucous cavities, as in hæmophilia (p. 79). Purpura is merely a symptom of some disorder of the health or the blood, and its treatment must depend on a thorough knowledge of its cause.

Without this the ordinary astringents and hæmostatics will be prescribed in vain.

Scurvy is a specific disease, and in no other sense a disease of the skin than that one of its symptoms is subcutaneous hæmorrhage in the form of vibices and petechiæ, just as the bleeding of the gums is another and still more prominent symptom.

Vesiculæ.

A vesicle is a small elevation of the epidermis, which is separated from the true skin by the effusion between them of a clear serum. This is usually the result of inflammation, and accordingly the neighbouring skin is generally seen to be red and congested.

The vesicular eruptions are sudamina, miliaria, eczema, and herpes.

Sudamina and miliaria.

The two first fall within the province of the physician, sudamina being the small clear vesicles which appear in the course of certain fevers, apparently only as the result of obstruction of the sweat-ducts ; and vanish in a day or two. Miliaria are vesicles which are found in acute rheumatism, and in children or adults with very tender skin in the summer months, often mixed with roseola, and display more distinct traces of inflammation than sudamina do, being surrounded by a red halo, and easily passing on to suppuration. In some cases a fever accompanied by miliary vesicles (miliary fever) prevails as an epidemic.

Eczema.

Eczema is the commonest of all skin-diseases. It is characterised by the eruption on patches of inflamed skin of a thick crop of small vesicles, together with scattered vesicles each surrounded by its halo of vascularity, but unaccompanied by any diffused inflammation of the skin. The vesicles burst and the epidermis then may form scabs or scales on the surface, so that the eruption in this state may appear to be squamous ; or, on the other hand, the fluid in the vesicles may become purulent, and then the eruption will resemble the pustular—impetigo. Successive crops of vesicles may make their appearance as the former die away. The fluid is strongly alkaline in reaction, and often as it oozes away it seems to scald or burn the skin, and a smarting sensation in the parts often accompanies the eruption and justifies its appellation. It is a very common eruption on the leg, and is often accompanied by an ulcer—the eczematous ulcer above described (p. 400). Eczema is often nearly allied to gout, and the urine accordingly will be found to contain lithic acid or oxalate of lime.

Varieties of eczema are described by Hebra without any vesicular eruption —i.e. a diffused inflammation of the skin resembling eczema in its constitutional complications (or rather causes) and in its seat, but characterised by the separation of the epidermis from the skin in papules, scales, or pustules, instead of vesicles. The papular form would be classed by others as lichen eczematodes, the scaly as pityriasis rubra, the pustular as impetigo or eczema impetiginodes ; but the differences are obviously immaterial.

The recognised varieties of eczema are E. simplex, when the inflammation of the neighbouring skin is not severe ; E. rubrum, when the skin is much inflamed ; and E. impetiginodes, when the vesicles rapidly suppurate or are mixed with pustules. Hebra describes a form as E. marginatum,

Syphilitic eczema.

which is by many writers considered to be syphilitic, and there is no question that eczema may appear as a secondary syphilitic eruption, though it is not a common symptom of syphilis.

Eczema appears at all periods of life and in all parts of the body. 'The face, the hairy scalp, and the skin behind the ears are all common seats of

eczema; but there is no part of the trunk or extremities which it may not, nay does not, frequently affect. Before and during the first dentition, eczema is by far the most common of the diseases of the scalp.'—Jenner. It is never contagious.

Its causes are constitutional and local; the latter depending sometimes on the irritation of itch, or parasitic animals, or on that of the material in which the patient works, as the 'bakers' itch.' These varieties are the most easily cured by withdrawing the irritation on which the disease depends. The kinds of eczema which depend on gouty, strumous, diabetic, and other constitutional conditions are often excessively obstinate.

The treatment will consist in the first place in discovering and, if possible, counteracting the causes on which the inflammation depends, then in diminishing the inflammation of the skin by soothing and slightly astringent lotions or ointments, accompanied, of course, by suitable position of the parts, with moderate purgation and an antacid regimen if the condition of the urine indicates it; and in the more chronic condition, when the disease approaches more to the scaly eruptions, by the application of some of the tarry substances (such as the ung. picis liquidæ or the petroleum Barbadense) with a course of arsenic. If syphilis be present or suspected, a mild and prolonged course of mercury or mercurial fumigation should be tried. When the scalp is affected, the hair must be most thoroughly and carefully removed with scissors, and the scales and scabs detached by a cap of gruel or a bread and milk poultice or linseed oil; after which Hebra recommends the application of liquid pitch if there is not much inflammation. While the eruption is in the 'weeping' stage the discharge must be absorbed by blotting-paper, or wet strapping, or soda lotion (sodæ subcarbonat. ʒij., aquæ Ojss).

Herpes is an eruption of vesicles situated in small groups on slightly inflamed skin. It differs from eczema in many respects, chiefly in the fact that the vesicles form a far more prominent feature of the eruption than in eczema, and the inflammation of the skin is far less marked. The vesicles also are usually larger than in eczema, and the fluid which they contain is less alkaline. There is also no such connection with chronic constitutional disease, or with any abiding local irritation, as is constantly found in eczema. Herpes.

The varieties of herpes are as follows:—

Herpes labialis is a very common affection which occurs sometimes from cold, but often with no affection of the health whatever. The vesicles become more or less pustular, then crack, and the scabs fall off and leave the skin below a little irritable for a few days, the whole affair being generally over in about a week. The prepuce is another common seat of herpes, and when these little cracks occur after a suspicious connection they often cause the patient much alarm. Their number and their perfectly superficial situation will disclose their nature, and the application of a little mild mercurial ointment will in a few days remove all cause for apprehension. No treatment is required for these simple forms of herpes beyond a purge, some care in diet, and the use of citrine ointment, or an ointment of grey oxide of mercury, gr. x-xv. to the oz. Lemon-juice is a favourite application in herpes labialis, and there are a thousand domestic remedies for what is after all a spontaneously curable affection.

Another form of herpes follows the distribution of one of the sensory nerves, and is often complicated by severe neuralgia of that nerve. The best known example is herpes zoster or shingles (*cingulum*, a girdle) which follows the distribution of one of the intercostal nerves, extending from the back to

the sternum.[1] This is generally preceded by some fever and severe pain in the part, and often neuralgia persists in the part for some time afterwards. In some few cases the herpetic patches ulcerate or even slough. The eruption runs its course in about a fortnight, and is said seldom to affect the same individual twice. It requires in itself no treatment beyond a purge and some soothing application. The neuralgia which it leaves behind may require prolonged and careful management. Other forms of neuralgic herpes occur in the face, following the distribution of the fifth nerve, and sometimes complicated with iritis, and in other nerves also, but more rarely.

Herpes phlyctenodes is a variety found on the face, in which the vesicles are unusually large. H. iris is a rare variety in which there is a ring of vesicles arranged around a central one, and each surrounded by concentric circles of various shades of red. It is found usually on the back of the hand.

H. circinnatus is when the eruption occurs in a red ring and spreads from the centre. Sometimes the vesicles are large, and it runs the ordinary course of herpes in other parts, disappearing in about a fortnight. But the form of the disease in which the vesicles are so minute that they often pass unnoticed, and the eruption appears to be of a furfuraceous character, is exceedingly obstinate, and is one of the eruptions known in popular parlance as 'the ringworm.' It occurs on the face, trunk, and extremities, and is contagious; is often mixed with the parasitic disease—tinea tonsurans—on the scalp; and its secretions seem to afford a nidus in which the parasite grows. The eruption spreads centrifugally; the original ring disappearing and giving place to a larger one, and so on. Its causes are local, and it is curable by local treatment—the application of strong astringents, as sulphate of iron or gallic acid—of strong acetic acid, nitrate of silver, or blistering fluid.

Bullæ.

A bulla or bleb differs from a vesicle only in size. It is a cavity between the skin and epidermis filled with serous fluid.

The bullous eruptions are two—pemphigus and rupia.

Pemphigus.

Pemphigus, otherwise called pompholyx, is an eruption of large bullæ, often in small numbers, sometimes even solitary, with little or no inflammation around them, attaining in some cases an enormous size, and containing pure serum, alkaline at first, which may turn acid and become puriform. The bullæ burst and the epidermis dries down into a scab, while fresh bullæ probably form.

Syphilitic pemphigus.

Pemphigus is sometimes due in infancy no doubt to congenital syphilis, and this is distinguished from the ordinary eruption by appearing on the feet and hands, and in some other cases it may be a tertiary symptom in later life. It occurs also as an acute disease attended with a febrile disturbance—febris bullosa. It also occurs in an acute form in old and cachectic persons; but more commonly it is a chronic eruption, and depending on visceral disease.

The treatment must be directed mainly to the constitutional condition. In the syphilitic variety iodide of potassium is indicated, with generous diet and opium. In cachectic persons the treatment must vary with the nature of the cachexia.

The blebs should be pricked; the part pencilled with a strong solution of nitrate of silver (℥j. : ℥j.), and after the cuticle has been thus hardened into a

[1] In some cases it is found in the course of the intercosto-humeral branch as well as the intercostal trunk.

scab, this should be detached by a poultice. If the cutis be ulcerated below, the ulcer should be stimulated with nitrate of silver.

Rupia originates as a bullous eruption, the bullæ being comparatively small and seated on an inflamed base; but the contents of the bullæ soon become purulent, and the pus dries up into a rough, coarse, prominent scab which remains attached for some time, and when it falls off leaves a circular ulcer —the rupial ulcer. Sometimes the ulcer spreads without any falling off of the scab, and then a larger scab forms under the original one and raises it up, and so on until a projecting mass of scab is formed like a limpet-shell. This variety is called R. prominens. Other varieties are R. escharotica, marked by a spreading or phagedænic condition of the rupial ulcer, and R. gangræ-nosa, when the surface of the ulcer sloughs. Rupia.

Rupia, particularly the R. prominens, is a frequent symptom of tertiary syphilis, especially in cachectic or dissipated persons, but it occurs also in other conditions of general cachexia. Syphilitic rupia.

In its second stage, when the contents of the bullæ have become purulent, it is hardly to be diagnosed from ecthyma, except by the more decided inflam-mation round the pustules in the latter disease. Later on, the prominence of the scab in rupia is plainly distinguished from the sunken adherent scab of ecthyma.

The treatment of all forms of rupia must be by supports and stimulants; for the patients are always broken down in health. In the syphilitic variety, rest, shelter, equable temperature, good diet, opium, and sarsaparilla should precede any specific treatment. Then iodide of potassium may be administered for a long time, followed by mild mercurial fumigation. In other cases various tonics and stimulants will be found serviceable. In the earlier stage of the eruption the bullæ should be punctured at once. When scabs are formed they should be removed, and the exposed surface dressed with some stimulant.

A pustule is a small collection of pus under the epidermis, and generally seated in the substance of the true skin. 'The inflammation, on which the formation of pus depends, extends some depth into the cutis, so that the collection of pus which constitutes the pustule is situated in the cutis, and not merely on it immediately beneath the cuticle.' Pustules are divided into three sorts, viz., *psydraciæ*, in which the pustule forms in a hair-follicle, and the hair is seen passing through the pustule, the skin around being inflamed; *phlyzaciæ*, which are rather large collections of pus seated on inflamed bases, which burst and form thin brown scales; and *achores*, which are small pus-tules, usually in considerable numbers, with much redness of the intervening skin. Their secretion dries up into thick yellow crusts like dried honey. They are formed by the inflammation of the hair and sebaceous follicles. Pustulæ.

Impetigo and ecthyma are the only diseases which are to be described here. Equinia and variola are added in the formal classifications, but the former is a special lesion treated of elsewhere (p. 74), and the latter is not properly a skin-disease.

Impetigo is almost as common a disease as eczema. It is characterised by a copious eruption of pustules both psydraciæ and achores, and by the thick honey-like crusts which they leave, as well as by the glandular enlarge-ment which always (according to Sir W. Jenner) accompanies the eruption. The seat of the suppuration is in the hair-follicles, at any rate in the great majority of cases; though in some instances impetigo may be found in places where there is no hair, as beneath the nails.[1] The connection between eczema Impetigo.

[1] See Nayler, op. cit. p. 170.

Eczema impetiginodes.

and impetigo is a very close one. True impetigo often follows eczema, and often also a mixture of the two eruptions is met with; the vesicles of eczema either suppurating rapidly, or being mixed in places with the pustules of impetigo. To this form of eruption the name eczema impetiginodes is properly applied.

Impetigo is divided into a great number of species derived either from its seat (I. capitis, faciei, &c.); from the arrangement of the pustules, I. sparsa, I. figurata, where the pustules are approximated on a defined patch of inflamed skin; from the nature of the crusts left, I. larvalis, when the face is covered by a thick crust, like a mask; I. scabida, an obstinate affection seen in the lower limbs of adults, and often combined with anasarca; I. granulata, when the crust, after separating from the skin, remains attached as a small lump to the hair; or from the course of the disease, I. acuta, I. chronica. These are only some of the many subdivisions which have been made of this eruption. Impetigo is in some measure contagious, i.e. the disease may be implanted by means of the pus, from the pustules or crusts. Thus it may be transferred from one child to another by wearing the same cap. Its contagion, however, is conveyed by actual contact, not through the air, as a fungus may be carried.

Porrigo.

Impetigo capitis, one of the most common varieties of the disease, is still sometimes called Porrigo, a term used by Willan and Bateman in a somewhat indefinite manner. It is well therefore to explain that, as Sir W. Jenner says, 'Willan figures six varieties of his genus porrigo; of these, P. larvalis and P. favosa are merely varieties of impetigo. P. furfurans is a species of eczema, P. scutulata is tinea tonsurans. P. lupinosa is tinea favosa, and P. decalvans is tinea decalvans.' But that Willan's description is not absolutely clear may be inferred from the fact that other recent writers interpret these terms somewhat differently.

Syphilitic impetigo.

Impetigo occurs as a syphilitic eruption, but is not a common one, and usually in persons whose general health is bad. It is remarkable for the large extent of its patches, and is usually mixed with syphilitic tubercle.

Other causes of impetigo are the irritation of the hands by sugar—'grocers' itch'—the irritation of dirt or stone-grit; and of lice in the head. Equinia is only a variety of this local impetigo.

The distinctive characters between impetigo and sycosis are given below (p. 915). From ecthyma it may be distinguished by the smaller size of the pustules in impetigo, and by their having no base; from favus, by the absence of any parasite; from eczema, by the implication of the hair-follicles.

Its treatment should be to cut the hair off as completely as possible, and remove the crusts by poulticing, and then apply some slightly stimulating ointment—'ung. zinci, ung. hydr. nitratis, ung. hydr. nitr. oxydi, ung. sulph. iod., and ung. sulph. hypochlor., are all occasionally useful, and one will sometimes answer when the others have failed, and without the reason being apparent.'

But combined with this local treatment must be general regimen and medicine appropriate to the individual case. Alteratives and tonics are almost always required, quinine being the most useful. Change of air, sulphurous waters, and sulphur baths—especially when the disease is syphilitic—are often of great service.

Ecthyma.

Ecthyma is a disease difficult to distinguish from the early stage of rupia, if indeed there be any distinction. Many authors (e.g. Mr. Nayler) include

the two eruptions in a common description; others, as Dr. Bristowe, regard ecthyma as being another form of impetigo. Ecthyma consists in an eruption of large phlyzacious pustules on a red, elevated, and indurated base, which burst and leave a brown scab. When this separates a red inflamed portion of cutis, or a small ulcer, is left. The pustules and crusts are never so large as those of rupia are, nor do the latter assume the prominent adherent shape of rupia. It is a cachectic affection, frequently depending on syphilis; often preceded by burning pain in the part from which the pustules afterwards spring. The usual duration of the disease when due simply to depression of the general health is only about a fortnight: but it is apt to recur or to propagate itself in the form of a constant succession of crops of pustules, and so becomes chronic. In the variety which is complicated with purpura (E. luridum), the pustules are surrounded with an areola of a purple colour, in consequence of hæmorrhage. The eruptions which follow on the irritation of tartar emetic or sugar, applied to the skin, are variously classed as impetigo or ecthyma, according as the affection of the hair follicle is or is not regarded by the classifier as an essential character of impetigo.

Little local treatment is required in ecthyma. The crusts should not be detached, as they protect the skin below. The part should be defended from friction or irritation by some simple ointment, and the same general treatment pursued as in rupia.

Papulæ.

A papule, or pimple, is an elevation of the cutis covered by its cuticle; the elevation being due to effusion of inflammatory lymph into the substance of the true skin.

A pimple differs from a vesicle not so much in its cause as in its extent of development. Both are due to inflammatory effusion in the substance of the skin: when this effusion separates the epidermis from the cutis a vesicle results; when it is confined to the substance of the cutis the result is a papule. Hence some excellent dermatologists (among whom I may refer to Dr. Bristowe[1]) consider all the following papular eruptions as only different forms of the same disease with eczema.

The diseases classed as papular are strophulus, lichen, and prurigo.

Strophulus.

Strophulus, the common 'red-gum,' is a disease of infancy characterised by the eruption of small pimples, usually red and close together, S. confertus —sometimes white and rather large, S. candidus[2]—sometimes with red spots intermixed, S. intertinctus. The eruption is generally due to disorder of the bowels, or irritation about the gums, and is accompanied by slight itching in most cases; sometimes, in S. confertus, by a good deal of distress from irritation and cracking of the skin. It will in most cases subside in a few days with some aperient, and attention to the state of the gums and of the digestion. Care should be taken not to confound this fugacious affection with the permanent lichen of congenital syphilis (see p. 3–4), and not to mistake flea-bites, or irritation of the skin from dirt, for strophulus.

Lichen.

Lichen is characterised by the eruption of a large number of red prominent hard papules which retain their shape, and to a great extent their colour, under pressure. There is often some itching and tingling about the part, and occasionally so much febrile disturbance that it is taken for an attack of measles.

[1] See the chapter on Diseases of the Skin, in Bristowe's 'Theory and Practice of Medicine.'

[2] There is an eruption of larger white papules called S. albidus, which, however, has been shown to be a form of acne, the elevations being really distended sebaceous follicles.

It is sometimes mixed with urticaria (L. urticatus), the papules becoming apparent as the wheals subside. It is a frequent syphilitic eruption, generally in the earlier stages of the constitutional affection, often becoming tubercular in its progress. Syphilitic lichen is known by its coppery colour, its appearance in curved figures (L. gyratus), its occasional presence on the soles of the feet, especially in infants, its tendency to crack at the base, and the history or concomitant symptoms of syphilis.

Syphilitic lichen.

Other forms of lichen are the L. tropicus or 'prickly heat,' a familiar disease in hot countries, and often seen here in hot summers, though in a milder form; L. circumscriptus, where the pimples appear in defined patches; L. pilaris, where each papule is found on a hair follicle, and has a hair running through it; L. agrius, characterised by the numerous hard rough pimples, generally on the face, where the skin feels like a nutmeg-grater, and by the excessive itching; L. lividus, a step between lichen and purpura, where the pimples are dusky red or livid, and purpuric spots may be interspersed, showing much cachexia and generally occurring in old broken-down patients; and, finally, the L. ruber of Hebra, in which large portions of the skin become inflamed and thickened, with a copious eruption of dark red papules on it, the thickening of the skin impeding motion, and the disease generally running on to a fatal termination.

Simple cases of lichen will be cured by purgatives, the avoidance of all sources of heat, simple unstimulating diet, and tepid or cold bathing, mucilaginous baths being most to be recommended. In the chronic forms arsenic (as in other dry eruptions) is of the greatest service. The syphilitic variety is under the control of mercury, and Mr. Nayler regards mercury in small doses as being of service in all forms of lichen. The itching is allayed by sponging the parts with vinegar or lemon-juice, and anointing them with dilute citrine ointment, or by a prussic acid lotion—3jss. or 3ij. of the dilute acid to six ounces of almond emulsion, or of rose water to which a drachm of liq. potassæ may be added.

Prurigo.

Prurigo is an eruption characterised by its itching and by the presence of flattened papules, so much the colour of the skin as to be with difficulty perceived in some cases. The itching is increased by any stimulant or by heat, so that it often becomes intolerable in bed. Prurigo is often mixed with urticaria. Sometimes there is a sensation as of insects crawling over the skin, P. formicans. Old persons suffer from prurigo, which is then called P. senilis, and is often very obstinate. In younger subjects it usually disappears in a short time. There is no doubt that in many cases the complaint is caused by the presence of lice, and such cases may be cured at once by destroying or baking the clothes, and by free bathing and the application of the white precipitate ointment. There are other cases in which the prurigo is local, usually about the genitals or anus—P. podicis, vulvæ, scroti, &c. In these cases the designation is usually a misnomer. The disease should be called pruritus, for there is intolerable itching, so that the patient is sometimes withdrawn from society by the impossibility of abstaining from scratching the part, but no pimples can be seen. Prurigo or pruritus is also sometimes a sequela of another eruption, i.e. intolerable itching in the part is left, after the previous eruption has disappeared. This is most common after eczema and scabies.

The first principles of treatment in prurigo are precisely similar to those in lichen. The patient's bowels must be cleared, his digestion regulated, and all causes of heat and irritation avoided. In pruritus ani, vulvæ, &c., any unnatural condition which can be detected must be remedied. The former some-

times depends on ascarides, or on fissure, the latter on the presence of a vascular tumour of the meatus, or on the habit of self-abuse. The most various local applications are in use and appear of advantage; of these the mercurial lotions and ointments, or lotions of sulphuret of potassium, sulphur baths and ointments, and prussic acid lotions have the greatest reputation. Whatever is found best to allay the itching should be kept at hand for immediate application when the patient becomes warm in bed, and he should abstain as much as possible from scratching.

Squamæ or scales are collections of dry epithelium, loosely connected to the subjacent skin, so that they may be easily rubbed off. Squamæ.

The squamous diseases are pityriasis and psoriasis. One form of pityriasis due to the presence of a parasite has already been spoken of as *chloasma*. The characteristic of pityriasis is the smallness of the scales, like those of bran, and the ease with which in most cases they fall off. The common pityriasis, or dandriff of the scalp, is the most familiar example of the disease. Pityriasis is also often produced by drying the skin imperfectly after washing, and then exposing it to the sun or wind. In these cases the skin is often a good deal reddened, and the disease is then called P. rubra. Pityriasis has the closest relation to roseola, and is regarded by Dr. Bristowe as merely the desquamative stage of that eruption. Pityriasis.

In the treatment of pityriasis the object is to slightly astringe the vessels of the skin and soften the epidermis, protecting the part from any irritation by some mild ointment. Borax is the lotion generally used, and diluted white precipitate ointment. The hair ought to be cut short and very gently brushed, and if it falls out (as is very common), a liniment of equal parts of acetum cantharidis and spirit of rosemary may be applied. Any derangement of health or digestion must be at the same time attended to. The hair may always be expected to grow again.

Psoriasis is an exceedingly common disease, both without and with spyhilis. It is characterised by shining white scales situated on slightly inflamed portions of skin. In the ordinary non-syphilitic psoriasis these patches have no definite figure: they are situated mainly on the coarser parts of the skin, chiefly on the outer sides of the limbs, the elbows, and the knees. Another form is called P. guttata, in which the patches are very small and seem as it were to have been dropped or dredged on the skin. When the affected portions of skin assume a circular form the disease used to be called lepra; by others this appellation is reserved for syphilitic psoriasis, which, like other syphilitic eruptions, is prone to assume a circular or curved shape, and which does not show any such preference for one over the other aspect of the limbs as P. vulgaris does. Psoriasis. Lepra. Syphilitic psoriasis.

The other varieties of psoriasis are of less importance. When very extensive it is called 'diffusa;' when peculiarly obstinate, 'inveterata;' &c. Psoriasis is often an accompaniment of struma, and is habitual with some persons, who suffer from it regularly at intervals.

The syphilitic variety requires mercury in some form. It is a secondary eruption in most cases, and is usually rapidly cured by fumigation. In non-syphilitic cases the great remedy is arsenic, which should be pushed till the characteristic effects of the poison begin to be manifested, or arsenic may be exhibited in combination with mercury, as in Donovan's solution. In cases which are not cured by arsenic, cantharides or pil. picis may be tried, and copaiba is said sometimes to succeed. Tar in some form is the best local

application, as the unguentum picis, or the Barbadoes tar. Sulphur baths and vapour baths are also often useful.

Tuberculata.

Tubercles are pimples on a larger scale, i.e. solid hard elevations of the cutis.

The tuberculous diseases are of the most varied clinical characters. They are acne, lupus, molluscum, elephantiasis, frambæsia, and keloid. Cancer is sometimes added, which indeed forms tubercles in the skin in some rare cases, but cannot properly be classed as a skin-disease.

Acne.

In acne the tubercles are caused by obstruction of the sebaceous follicles and effusion into the skin around them. Suppuration often occurs at the apex of the tubercle, constituting acne simplex vel punctata, so frequently seen on the neck, face, and shoulders, intermixed with black points, which are the orifices of the sebaceous follicles, from which a worm-like mass of secretion may be pressed, which is popularly regarded as a parasitic animal, and which does often contain a microscopic parasite, the acarus folliculorum.

In acne indurata the hardening and thickening around the tubercles is greater, the tubercles coalesce, causing great deformity, and there is little tendency to suppuration.

Acne rosacea is chiefly seen on the nose and parts adjacent, and has been spoken of on p. 601.

Acne sebacea is a rare form of acne, characterised by a superabundance of the sebaceous secretion, which sometimes covers the skin, dries upon it, and turns hard and black, constituting what is called (not very accurately) spurious or sebaceous ichthyosis.

The treatment of acne is in great measure local, consisting in opening the sebaceous follicles by bathing and friction, pressing out the secretion from them, and puncturing the tubercles which have suppurated. The tubercles may be lightly touched with acid nitrate of mercury, or strong nitric acid. Lotions of bismuth and mercury, or mercurial and sulphur ointments, may then be useful as permanent applications.

At the same time much care must be used in regulating the diet, correcting any excesses in it, and forbidding the use altogether of anything which can promote acidity.

Syphilitic acne, or syphilitic tubercle.

The term syphilitic acne used to be applied to the tubercular eruption so often seen on the face in the later stages of secondary syphilis, but incorrectly if the word acne is restricted to an affection of the sebaceous follicles. The colour of the eruption, its dense arrangement over the face, and the presence of other syphilitic symptoms sufficiently mark its nature. There is not the tendency to suppuration which is seen in true acne, and a mercurial course is generally followed by its rapid subsidence.

Molluscum.

Molluscum is a singular disease, seen usually in children, in which there is a crop of large tubercles, frequently of a dead white or of the natural colour of the skin, many of them presenting a dark point with a depression, and regarded as being obstructed sebaceous follicles, others having no such depression. Molluscum is regarded by many authors as contagious, and Hardy teaches that a cryptogamic plant is to be found in it, but others doubt that the eruption possesses any such property. The only treatment required is to lay the tubercles open and rub their interior with caustic, or to snip them off. There is no constitutional affection.

Mr. Pollock has lately communicated to the profession two cases of a very peculiar affection in women, bearing some resemblance to molluscum, in

which large pendulous fibro-fatty masses occupied a great part of the neck, chest, and other portions of the body. In one of these cases much benefit followed on the removal of some of the largest of these pendulous masses; in the other case the patient died from the effects of the operation.[1]

Lupus is a disease characterised by a tubercular eruption which in most forms of the disease perishes in a destructive ulceration, leading to the 'lupous ulcer' spoken of on p. 403. Various forms of lupus are described, all of which are most frequent on the face, and chiefly on or near the alæ nasi, though all may occur on other parts of the body. Lupus is never contagious; it shows little tendency to recovery except under careful and often protracted treatment. The varieties described by Mr. Nayler are as follows:— Lupus.

1. Tubercular lupus (or lupus non-exedens), in which there is an eruption of pale tubercles which become red under excitement, and which remain in much the same condition for years, crusts like those of eczema forming on them, occasionally but very rarely ulcerating. 'It is not infrequent to find the disease, after the lapse of twenty years and more, not exceeding in diameter that of a crown-piece.' This is essentially, as it seems, a strumous affection, and leads naturally to the mention of—

2. Strumous lupus, in which the tubercles rapidly give rise to a superficial painless ulceration, which slowly advances for an indefinite time, cicatrising in parts, and often causing ectropium or other deformities.

3. Lupus exedens is a form in which the destruction of parts is much more active than in strumous lupus. It commences with a small hard tubercle; and as other tubercles form, the original ones break down into a rapidly spreading ulcer with a light yellowish surface, which perforates all the tissues and sometimes destroys the nose altogether, at other times heals, or is brought to heal, and leaves a peculiarly sharp or pointed edge with a purplish colour.

4. Syphilitic lupus is, in fact, syphilitic tubercle, complicated with ulceration, or syphilis attacking a person affected with one of the previous forms of ulcerating lupus, which generally adds to the severity of the disease and the destructive nature of the ulceration.

5. Impetiginous or papulo-pustular lupus is a name given by Mr. Startin to a form of the strumous variety in which numerous pustules resembling those of impetigo are found on the part affected.

The treatment of all these forms of lupus is by some powerful escharotic. For the tubercular and exedent forms nitric acid, the acid nitrate of mercury, or potassa fusa is appropriate, any scabs being removed, the surface carefully dried, and the caustic thoroughly applied to a small portion of the tuberculated surface in the non-exedent form and to the whole ulcer under chloroform in lupus exedens. For strumous and impetiginous lupus Mr. Nayler recommends an arsenical and calomel caustic—acid. arseniosi gr. iij., hydr. bisulphuret, gr. ij., hydr. chlor. 3j., the powder to be made into a paste with water, and applied with a camel's hair brush after the scab is removed. In late years a more active surgical treatment has been adopted in the rapidly advancing forms of lupus, and in many cases it will be found to be of very signal benefit. This consists in removing the whole surface of the affected part with Volkmann's spoon or some other raspatory. I have often practised this treatment, and with much satisfaction. Other surgeons speak of the beneficial effects of scarification, i.e. a number of superficial incisions, or scorings, drawn from

[1] See 'Med.-Chir. Trans.' vol. lvi., and 'Path. Trans.' vol. xxvi.

healthy tissue on one side of the diseased surface to the other, and then crossed by others at right angles to them. Anæsthesia is usually necessary for either plan of treatment. In most cases the anti-strumous regimen, or cod-liver oil with small doses of arsenic, proves serviceable; but active local treatment is in all cases urgently requisite.

6. To these forms Mr. Nayler adds another, for a complete account of which I must refer to his work on Diseases of the Skin, or to the article in the 'System of Surgery': the erythematous, commencing as a patch of erythema on the face, and this becoming covered with scales or crusts adhering to the surface, seldom ulcerating, but terminating either in complete recovery or in a white cicatrix on a level with the surrounding skin. The disease is usually seen after middle life, generally in women, and prevails more in the upper classes than in those who have been exposed to hardships. The remedies recommended are stimulating applications to the patch, as nitric acid lotion, if there is much redness, alternated with borax and hydrocyanic acid, if there is smarting pain at night, or blistering in the early stage of the eruption. The internal remedies are mainly steel and arsenic.

Elephantiasis.

Elephantiasis is a name applied in common to two very different diseases, distinguished from each other as E. Græcorum, the tubercular leprosy, and E. Arabum, or Barbadoes leg.

Leprosy.

The former is an endemic disease which is at present unknown, or nearly so, in these islands, though it seems that it used to prevail here, and it is still prevalent on the Baltic coast; but its more favourite seat is in hot countries. It is more common in males than females, and is rarely seen till after puberty. It occurs in two forms, the anæsthetic and the tubercular. In the former the skin loses its sensibility in patches, the affected parts soon ulcerate, the fingers and toes shrivel and drop off, and the patient usually dies from some exhausting disease, as diarrhœa or dysentery. In the other form, after more or less pain in the part and disturbance of health, irregular discoloured patches of skin are seen, which become covered with small tubercles, the face, palate, eyes, and larynx are affected, and ulcerate; and the patient usually sinks gradually, or dies suddenly from laryngeal symptoms. The cause of the malady is unknown, nor does any treatment appear of use. The disease is plainly proved not to be contagious. Dr. Vandyke Carter has published (in the 'Transactions of the Med. and Phys. Soc. of Bombay,' and in vols. xiii., xiv. of those of the Path. Soc.) some very interesting researches showing the atrophied condition of the sensory nerves in leprosy. As the disease is not seen in this country, and is more a medical than a surgical affection, it is unnecessary to dwell on it here.

Elephantiasis Arabum.

The elephantiasis which we are called upon to treat surgically in this country is that which is called E. Arabum, or Barbadoes leg. It occurs in the lower extremity or in the genitals, and no doubt originates spontaneously in this country, though it is not prevalent to any extent—in fact, is rare, apart from some cause of obstructed circulation. In the leg the limb swells enormously, mainly from hypertrophy of the cellular tissue; the skin becomes hard, thick, and warty, and in some cases distinct tubercles are developed upon it. It cracks and ulcerates, and sometimes the toes drop off. In many cases (at least in the tropical disease) there are intermittent attacks of fever, and in the opinion of some experienced practitioners the disease owns a malarious origin, or is excited by the presence of the guinea-worm (see p. 868). In other cases it seems to be venereal. In some cases it appears to be connected with lymphatic fistula. I once had a patient under my care, labour-

ing under elephantiasis of the labia and thigh, in whom during the febrile paroxysms clear fluid displaying lymph corpuscles under the microscope exuded from minute openings in the groin and vulva. The treatment of elephantiasis, as far as I have seen, has not been very successful. The size of the limb may be much reduced, especially in recent cases, by careful pressure and the application of mercurial lotions and ointments, or by iodine, with the administration of biniodide of mercury in small doses, but I believe that the disease generally, if not always, reappears. The ligature of the main artery of the limb was practised by Dr. Carnochan, of New York, and spoken of at first as universally successful; but since its more extended trial in this country, it has been so clearly shown that the benefit which follows the operation is in most cases but temporary as to render it probable that it always is so, and that the operation ought only to be considered in the light of an experiment, which failing, amputation of the limb is indicated. Considered in that light, it may be justifiable to tie the femoral artery. Failing this, when the enlargement makes the patient's life intolerable, it must be removed, whether the leg, the scrotum, or the vulva and labia are the seat of the disease (see p. 868).

Keloid. Keloid tumours, as usually seen, are developed in scars; and I have spoken of them on a former page (see p. 407). Dr. Addison has applied the same name to a condition which he calls 'true keloid,' but which is perfectly different from the flattened tumours (like gigantic tubercles) which arise from the cicatrices of burns, floggings, and other extensive and slowly healing injuries. Addison's keloid is not a tumour at all, but a patch of hidebound skin in which the skin fascia and muscles are adherent together, and the surface is yellowish and covered with scales. I am not aware that treatment has any effect on this condition.

Frambæsia. Of frambæsia, or yaws, I will merely say that it is a highly contagious eruption of red tubercles, soon ulcerating, which affects chiefly the negroes in the West Indies, but has been seen in remote parts of Scotland and Ireland.

Maculæ. I need only enumerate the maculæ, or permanent stainings of the skin. None of these affections come under the treatment of the surgeon; and, in fact, they are hardly under the dominion of any treatment. They are the '*bronzing*' of the skin connected with the degeneration of the supra-renal capsules found in Addison's disease; the '*moles*,' or congenital deposits of pigment, which are so often found covered with hair, and which are liable occasionally to degenerate into epithelioma; the '*silver-stain*,' or lividity of the surface which is found in persons who have taken nitrate of silver internally for a long time; and the want of pigment which when universal is called '*albinism*,' and when localised in patches '*vitiligo*.'

Parasitæ. The diseases excited on the skin by the growth of a vegetable parasite are tinea tonsurans, tinea decalvans (possibly), tinea favosa, tinea sycosis or simply sycosis (mentagra), and chloasma or pityriasis versicolor.

Tinea tonsurans. Tinea tonsurans is exceedingly like herpes circinnatus; so much so that by some they are classed as the same disease, and both are included in the popular term 'ringworm.' It is seated on the hairy scalp, and is only seen in children, seldom before two or after twelve years of age. It appears in round patches covered with white scales, and here the hairs are so completely removed that the places seem to have been shaved; but on minute examination, short thick twisted hairs will be found among the scales, and the hair-follicles can

be detected, and after its cure the hairs will always grow again. The disease is caused by the growth in the hair of a vegetable parasite—the trichophyton tonsurans.[1] This embeds itself in the secretion of the hair-follicles which is believed to be unhealthy, and as it grows into the hair it causes it to swell and become brittle, so that it breaks off and comes away. The spores of this plant may be found also in the epithelium of the patch, which is heaped up in opaque white scales.

The treatment is directed to the destruction of the parasite. Strict cleanliness must be enforced, the epithelium removed by a lotion of borax, and an ointment rubbed in twice a day to destroy all the spores of the fungus. Sir W. Jenner recommends 5 grains of the ammonio-chloride of mercury to the drachm of sulphur ointment for this purpose; or 2 grains of the perchloride to the drachm of lard; or 30 grains of nitrate of copper to 4 drachms of lard: or 10 drops of creosote to the drachm of lard; or strong blistering fluid or strong sulphuric acid, the part to be washed directly afterwards with cold water.

Tinea decalvans, or Alopecia circumscripta vel areata.

In so-called tinea decalvans the hairs are completely removed from the scalp, and sometimes from other hairy parts also, in large irregular patches, where the skin is perfectly bald with no trace of the truncated hairs which are found in tinea tonsurans. The skin exposed is smooth and paler than natural. This is said to be due also to the presence of a parasite—the microsporon Audouini—which, however, Sir W. Jenner says he has never been able to find either on or in the hairs about to fall from their follicles, nor has Mr. Nayler been more successful in his search for these sporules.[2] There is also no proof that the disease is contagious as parasitic diseases always are: accordingly in this country the disease is more frequently classed as 'Alopecia.'[3] The bald patches are bounded by definite margins, and as these areas fall into each other the whole scalp may become bald; nay I have seen a case in which the whole body was so, no trace of a hair being recognisable on any part.

Alopecia syphilitica.

Alopecia is also a common symptom of syphilis, especially common in the secondary syphilis of young girls and in congenital or acquired syphilis in infants. The remedies consist in the application of stimulants to the part. The bald patches should be painted about once a fortnight with blistering fluid, and left alone till the irritation has subsided, when a slightly stimulating ointment or lotion is to be applied till the time for the next blistering arrives. Liniments or lotions of ammonia seem well suited for this purpose (see p. 388). In syphilitic cases a mercurial course is indispensable. Slight cases, especially at early periods of life, and syphilitic cases, will probably get well; in very extensive alopecia, and in older persons, there is much reason to fear that the baldness will be permanent.

Tinea favosa, or favus.

Tinea favosa, or favus, is a very acute and formidable eruption of the scalp in childhood. It is due to the lodgment in the hair-follicles of the sporules of a fungus called the achorion Schönleinii. These give rise to an eruption consisting of brimstone-yellow crusts, cup-shaped, and each having a hair in its centre. These dry crusts are not uncommonly mixed with pustules of impetigo. As these crusts increase they kill the hair on which they form, and thus favus,

[1] I must refer the reader to some of the special treatises—such as that of Mr. Nayler—for the microscopical appearances of these parasitic fungi. In the judgment of some dermatologists, as Dr. Tilbury Fox, they are all different stages of growth of the same plant.

[2] 'Diseases of the Skin,' 2nd ed. p. 216.

[3] Dr. Bristowe (3rd. ed. of 'Syst. of Surg.') describes this affection, under the name of 'Porrigo decalvans,' as a disease of the hairs.

unless soon cured, may induce permanent baldness of the affected part. In some cases a peculiar and unpleasant odour is perceived (compared to that of cat's urine) but not always. Sir W. Jenner has noted that children affected with herpes circinnatus are peculiarly exposed to the contagion of favus, and has given interesting examples of this fact.

The cure of favus, as of other parasitic diseases, is procured by killing the parasite. For this purpose the hairs may be plucked out. The huile de cade is said to loosen their attachment, and the hairs have less than the normal tenacity of implantation in any case, so that when the disease is limited there is no great difficulty; but it becomes almost impracticable when the scalp is extensively affected. No doubt drawing out the hairs facilitates the application of the parasiticide remedies, but Mr. Nayler says that it is by no means necessary, and that after the usual preparatory cleansing, tar, or the ung. picis liquidæ, answers every purpose. In fact, these applications as they separate bring away the hairs with them. Then a saturated solution of sulphurous acid applied on lint covered with oiled silk, or perchloride of mercury in the proportion of 8 grs. to the ounce of lard, or acetate of copper, half a drachm to the ounce, are recommended for the destruction of the parasite. Favus affects the hairs of other parts of the body as well as the scalp. It is a rare disease, and only seen in the poorest and most neglected children. It is undoubtedly contagious, though not very actively so (see Nayler, op. cit. p. 245).

Tinea sycosis, or mentagra.

Sycosis is a disease of the beard and whiskers, very rarely of any other part, though Mr. Nayler refers to cases in which the eyebrows or the hair of the back of the neck have been affected, and I believe cases have been recorded in the female. It is due to the lodgment of a parasite—the microsporon mentagrophytes—in the hair-follicle, the presence of which excites an inflammatory swelling of the follicle, like that of the sebaceous follicle in acne, followed by suppuration. A hair is seen to traverse each pustule, which would sufficiently distinguish it from acne, to which otherwise it bears a considerable resemblance, as it does to impetigo; but in sycosis there is much more thickening around the pustules than in impetigo.

Sycosis is often very difficult to cure. The patients are frequently out of health, either from intemperance or starvation, so that the first thing is to correct either of these excesses, to bring the patient's digestion into good order, and supply him with a generous unstimulating diet. The scabs must be removed by poulticing, the hairs removed if possible, and some of the parasiticide ointments above prescribed applied. Iodide of sulphur ointment and white precipitate ointment are the favourite applications, but if the eruption does not yield to one another must be tried.

Chloasma, or pityriasis versicolor.

Another undoubtedly parasitic disease is the one so often seen on the chest and loins,[1] especially in young people of delicate skin and in others who neglect cleanliness, and especially who constantly wear the same unwashed flannel. The eruption, however, though favoured by such dirty habits, does not arise exclusively from them, for in some cases persons of scrupulous cleanliness are found to be affected. It never occurs in childhood. It is characterised by the presence of numerous circular brownish patches ('chloasma'), which, however, vary in shade from yellow to dark brown, or even a reddish tinge, in different persons, and in the same person at different times, whence its synonym, 'pityriasis versicolor.' The patches consist of epithelium which is bran-like and desquamating, and if these scales be removed and

[1] Other parts of the body are occasionally though rarely affected—the face very seldom.

examined in an alkaline fluid or, as Mr. Nayler recommends, in acetic acid, abundant spores and mycelium of the fungus—microsporon furfurans—will be detected.

The complaint is a very common one, and is consistent with the most perfect health—the only inconvenience the patient experiences being that his skin is irritable when he gets hot.

It is to be diagnosed from 'liver-spot' (lentigo hepatica), a very rare disease, which has no scaling of the epidermis and no parasitic origin, and which occurs in childhood as well as in after life—and also from the other kinds of pityriasis presently to be described.

Its cure must be sought, as before, in the destruction of the parasite, for which purpose all dirty habits must be reformed, the skin well rubbed, after thorough washing, with a flesh-brush daily, and then sulphur ointment or a lotion or ointment of bichloride of mercury will cure the disease, though it is very liable to recur. Like other parasitic diseases it is contagious.

Scabies.

The only parasitic animal which causes an eruption is the *acarus scabiei* or *sarcoptes hominis*, which burrows and hides itself in the deeper layers of the epidermis, and thus gives rise to an irritation which develops a definite eruption—'the itch'—of either a vesicular or pustular nature. The intolerable itching excites the patient to scratch himself, and thus much aggravates the eruption.

Scabies is seen first in the adult usually in the hands and wrist, especially in the clefts between the fingers; in children in arms on the buttocks. It is known by the itching and scratching and by the vesicles or phlyzacious pustules mixed with small cracks or burrows leading from the bases of some of the vesicles, and marking the spot where the animal may be found if the burrow be carefully opened with a needle and searched with a magnifying-glass.

The remedy for scabies is sulphur, which never fails to kill the animal, if only the disease is not excited by fresh parasites from the clothes. If these are fumigated with sulphur or baked for a sufficient time, and all parts affected with the eruption smeared well over with the ung. sulphuris twice a day, the patient will be well in a few days. Sir W. Jenner says that at the St. Louis Hospital at Paris a cure is obtained in two hours by the patient being well rubbed over with soft soap for half an hour, then smeared with an ointment composed of eight parts of lard, two of sulphur, and one of carbonate of potash for half an hour, and then placed in an alkaline bath.

If there is any objection to the colour or odour of the sulphur, the former may be concealed by the admixture of the bisulphuret of mercury, and the latter by a few drops of essence of bergamot.

Xero-derma. Ichthyosis.

The only other disease of the skin which I think it worth while to mention is the malformation which consists in the imperfect development or entire absence of the sweat glands and ducts, which produces the condition named ichthyosis, a condition characterised by the collection of dry scales over a part or the whole body; congenital in the worst cases, in others occurring in later life, as after the cessation of the catamenia. I merely mention the subject here in order to caution the reader not to confound pityriasis or psoriasis with this affection, which is, as Mr. Nayler says, rather a malformation than a disease of the skin, and which is sufficiently distinguished from those diseases by its history as well as by the appearance; for in ichthyosis it is not merely the scaly eruption, but also the thickening and dryness of the skin which constitute the morbid state.

I must now turn to the affections of the appendages of the skin. The only distinct disease which affects the hair is plica Polonica—a matted state of the hair of the scalp, and in rarer cases of other parts of the body, met with in Poland and the neighbouring countries. The matted hairs are stuck together by a glutinous material in which foreign substances are found, and in old-standing cases a fungus. The exact nature of the affection is not known. Most authors now adopt Hebra's explanation that it is due to eczema or some other skin-affection long neglected. Plica Polonica.

Corns are elevations of the epidermis formed by intermittent pressure, which acts as an irritant and produces inflammatory effusion. Continuous pressure, on the contrary, causes absorption. Corns are, for obvious reasons, usually found on the feet, though they may grow on any part which is irritated in a similar way, as on the fingers of tailors, musicians, or rowers; but it will be sufficient to speak of the ordinary corns of the feet. They are either hard or soft, the first being seated on the dorsum or more rarely the plantar aspect of the toes and feet, and consisting of thickened and heaped-up epidermis; the corn sometimes when it has lasted long producing absorption of the true skin, and then often having a bursa below it. They are peculiarly liable to form on toes deformed by the pressure of ill-fitting boots. They cause a good deal of pain in walking, and sometimes lead to more serious mischief, as to lateral curvature from the unequal use of the limbs. Or suppuration may occur in the bursa, or in the cellular tissue beneath the corn, and this may spread so deeply as to open the articulation or expose the bone below, and then may spread to the other surface of the foot, constituting one form of the 'mal perforant du pied' of French authors. Soft corns form between the toes, and bear a great resemblance to warts, consisting often of enlarged papillæ ensheathed by epidermis. They often grow to some size and then give rise to great annoyance, and they may inflame and suppurate as hard corns do. Another variety which also bears a certain resemblance to warts is the fibrous corn, sometimes seen on the sole of the foot, and formed of the papillæ of the skin covered with epidermis. These are often acutely painful, and from their position altogether hinder the patient from active exercise. Corns.

The treatment of corns in all their stages or forms must commence with correcting any defect in the boots and withdrawing the parts from pressure, which can be managed if necessary with a 'corn-plaister'—a piece of thick plaister with a hole in it to receive the corn. The hardened epidermis may be gradually rubbed down with glacial acetic acid or with nitrate of silver applied after the outer hard part of the corn has been pared, or with a corn-file; or the cuticle may be softened by the application of strong alkalies. The chiropodists cure corns by cautiously digging round the thickened epidermis till it can be turned out of the hole which it has formed in the cutis, which they call extracting the root of the corn. When suppuration forms beneath a corn the little abscess should be opened at once, and then the corn will often fall off altogether. When the corn forms on the back of a bent toe it cannot probably be cured till the toe is straightened. Soft corns may generally be cured by keeping the toes apart with a plug of cotton-wool, and steeping the corns in acetic acid or dusting them with oxide of zinc, pure or mixed with pulv. æruginis.

Perforating disease of the foot is an affection but very rarely met with, and which has hitherto resisted all treatment except amputation. It com- Perforating

disease of the foot.

mences as a small round sore, usually on the sole and near the metatarso-phalangeal joints, but occasionally on the dorsum, though always I believe near the level of those joints. The origin of the disease seems certainly in many cases to be in a suppurating corn; in others it seems to have some connexion with a morbid state of the nerves, as the skin is noticed to have lost sensibility, and to sweat profusely, and in these (as probably in others not accompanied by anæsthesia) it has no connexion with corns, commencing as an ordinary ulcer, preceded, as Nélaton teaches, by a phlyctæna. From its point of origin the disease extends, sometimes accompanied by severe pain, down to the metatarsal bones, which become necrosed, and thence to the tarsus, till at length the patient is fain to consent to the removal of the foot. This can be done by Pirogoff's or Syme's operation with every prospect of permanent relief. I have not, as yet, seen any other treatment of which I could confidently say that it had been permanently successful. In one case, however, I removed the outer portion of the metatarsus with the corresponding toes on both sides, and the wounds healed, and so long as I had the patient under observation she seemed cured. In an early stage of the disease, the free destruction of the ulcerating soft parts with caustics and the removal of all exposed bone are the most rational measures; but they hold out little promise of success, especially in cases complicated with anæsthesia. The most complete account of this curious affection is to be found in Mr. Hancock's 'Lectures on the Anatomy and Surgery of the Human Foot,' pp. 57 *et seq.*, while the literature of the subject is summarised and the microscopic anatomy of the diseased nerves illustrated in the paper by Mr. Butlin and Mr. Savory in 'Med.-Chir. Trans.' vol. lxii.

Bunion has been spoken of on p. 500.

Warts.

Warts are collections of hypertrophied papillæ covered with epithelium, and sometimes hardened on the surface by friction and exposure. They are situated very commonly on children's hands, and occasionally on other parts of the body. The verruca digitata or branching wart, which forms sometimes on the scalp in women; the sub-ungual warts which form below and at the side of the nails, and are very painful; and the verruca confluens, in which a crop of small warts collect into a mass on the back of the hand or arm, or on the neck and thorax, so that the skin resembles coarse plush, are varieties which deserve special attention on account of the desirability of eradicating them at once.

Venereal warts and condylomata.

The warts which occur from venereal causes, and which are very common on the female genitals, and to a less extent on the male, are due to the irritation of discharge retained in contact with the skin or mucous membrane. They often spread over a large surface and attain a considerable size. Those which are truly called warts consist of epithelium and papillæ only. The condylomata are masses often of very large size, consisting of all the structures of the skin hypertrophied, sometimes to an enormous extent, and covered with a copious warty growth.

Verruca necrogenica.

Other warts, which are due to the irritation of morbid fluids, are the dissection-warts or 'verrucæ necrogenicæ,' which are found occasionally on the hands of dissectors and morbid anatomists. Sometimes this irritation produces not exactly a wart, but a condition of skin marked by a thickening of all its tissues, and especially perceptible around the hair-follicles.

Chimney-sweep's cancer is sometimes spoken of as a kind of wart produced

by the irritation of soot, and certainly it commences with a warty or papillomatous growth on the surface of the skin; but at the time we generally see it the deposit of epithelioma extends far beyond the papillary structure.

No cause is known for the common warts. They appear and disappear in the most capricious manner. The venereal warts are no doubt contagious, and this is popularly believed of the common warts, and especially of the blood from them, but without any proved foundation. In some rare cases warts may become the seat of epithelial cancer, and they may in others prove the starting-point of horns, but usually they are merely a disfigurement. They may be removed by thoroughly soaking them in nitric acid or the acid nitrate of mercury or glacial acetic acid or perchloride of iron, or by repeated applications of stick-caustic. I have personal experience of the efficacy of the acid nitrate of mercury in the verruca necrogenica. The venereal warts must be treated by scrupulous cleanliness, by the application of the strong liquor plumbi, and by a mercurial course if other secondary symptoms are present, or they may be removed. When large condylomatous masses exist it is necessary to remove them; and, since severe hæmorrhage may take place in such operations, it seems better to avoid the knife if possible, and effect their removal with the écraseur or the elastic ligature.

Horns.

Horns are occasionally seen growing from the surface of the body in various parts. They originate either in accumulated sebaceous secretion, or from overgrowth of the epithelium, or from overgrowth of the nails, or from the hardening and continued growth of a wart.[1]

The whole horn must be removed, and if there is a sebaceous cyst at the bottom, this is also to be cut out.

Boils.

A common boil or furuncle is an inflammation of the skin and cellular tissue, limited to a very small extent, and containing in its interior a small slough of cellular tissue called the *core* of the boil. Another kind of boil, however, called a 'blind boil,' is less defined or limited, and contains little if any core. The common boil increases in size and painfulness for a day or two, forming a red angry lump in the skin, and then bursts, and the core or slough presents at the opening. This is drawn out, or gradually makes its own way, and then the inflammation and swelling rapidly subside, and healing soon follows. In some cases the furuncular inflammation gradually subsides, and the patient recovers without any suppuration. This, however, is not often seen in acutely painful boils.

In blind boils, after some days of pain and inflammation, a vesicle or a superficial pustule forms, and then the hardening gradually recedes and finally disappears.

The causes of boils are very numerous. Locally they may be caused by dissecting-room poisons, and perhaps by other morbid matters applied to the skin; but in the great majority of cases the cause is constitutional, and consists in some error of diet, some lowering influence, as parturition, or some disturbance of health from climatic causes. The surgical importance of the boil is usually trifling, but the remote cause should be carefully investigated, for the constant recurrence of a crop of boils--no infrequent event—is a very serious annoyance, and sometimes even a source of danger. The presence of sugar in the urine is sometimes associated with the appearance of boils

[1] See T. Smith and Godlee, in 'Syst. of Surg.' 3rd ed. vol. ii. p. 941.

of the lip, especially in young persons, is peculiarly apt to infect the blood and generate acute pyæmia.' No local measures are of any avail, except perhaps such incisions as are necessary to relieve tension.[1] The patient's only prospect of benefit from treatment seems to be in the copious administration of quinine, so as to produce the symptoms denominated cinchonism; but the statement above quoted from Sir J. Paget's experience shows how feeble the chance is.

Malignant pustule.

Malignant pustule, or 'charbon,' is a disease communicated to the human subject from herbivorous animals, usually cattle; though other animals may be the source of the infection when suffering from a disease known to farriers as 'the blood,' 'joint-murrain,' or 'quarter-evil.'[2] The name in common use is a very bad one, since one of the characteristic features of the disease is that pus never forms at the part inoculated. The usual course of a malignant pustule is 'at first a red spot, then a vesicle, then a solid and circumscribed swelling beneath, surrounded by a diffused and softish œdema, a dry leathery central eschar, and a secondary formation of vesicles or bullæ.'—T. Smith. Very striking features in the disease are the remarkable freedom from severe pain, the little increase in the temperature of the part, the dryness of the slough, the absence of pus, and the fact that the destruction of parts proceeds from the surface to the deeper parts, and not in the reverse direction, as in carbuncle or abscess. The complaint is prone to destroy life by a rapidly fatal form of septicæmia, in which the post-mortem appearances are chiefly seen in the alimentary canal, as in the third form of that affection spoken of on p. 34. The indications of treatment are to destroy the diseased tissue by some active caustic as early as possible in the complaint before the constitutional symptoms have set in. But the disease is one which, if it occurs often in this country, is certainly not often recognised here, and the difficulty would be to make sure of the diagnosis in time.

Chilblains.

Chilblain is an affection especially of childhood, though it is not confined to children. Men suffer from it far less than women. The affection consists in inflammation of the skin, often proceeding to ulceration (broken chilblains), and even in some cases to gangrene; but characterised by the peculiarity that the chilblains are liable to periodic attacks of congestion, generally in the afternoon or after dinner, sometimes after going to bed. Chilblains appear to be directly caused more by thawing after cold than by the immediate action of the cold itself. They attack the most exposed parts of the body—the hands, the lobes of the ears, the end of the nose, and particularly the feet, where the circulation is most languid. The persons chiefly affected are those whose hands and feet are liable to become cold and livid from slight causes.

Much may be done to obviate the tendency to chilblains by attention to the general health, by insisting on vigorous exercise, by warm clothing, and by good diet.

'As long as chilblains remain unbroken, and if the external surface is not too sensitive to pressure, various stimulating embrocations may be beneficially

[1] See a case related by Dr. Burrell, 'Am. Journ. Med. Sci.' July 1880.

[2] The disease is now known to be caused by the passage into the blood of a large microzyme called the 'bacillus anthracis,' and the same bacillus appears to cause the 'wool-sorters' disease.' See Dr. Greenfield's 'Brown Lectures,' 'Lancet,' 1880; and Pasteur in the 'Transactions of the International Medical Congress,' 1881.

employed: such as Wardrop's liniment, a mixture of two parts of tincture of cantharides with six of soap-liniment; camphorated spirit; equal parts of turpentine and copaiba; or tincture of iodine and soap-liniment. When the external surface is very tender, a good local application is formed by a mixture of two ounces of collodion, six drachms of Venice turpentine, and three drachms of castor-oil; or tender chilblains that do not itch may be covered over by adhesive plaster spread upon kid or chamois leather.'[1] Itching may be relieved by mustard baths, or by rubbing with snow. Vesicated chilblains may be coated with collodion and castor oil. For the ulcers a dressing of poultice and Friar's balsam, or of balsam of Peru, may be recommended.

The nails are liable to many disorders, of which it will be enough to enumerate the following:—

Onychia.

Onychia, or onychia maligna, is a peculiar form of foul ulceration around the nails of children, originating in a crush of the end of the finger, which seems to loosen the connection between the nail and its matrix. The end of the finger becomes unusually enlarged, red, and congested; and the nail is thinned, blackened, and separated from the soft parts by a very foul ulcer running like a crescent across the finger. This ulceration may go on till the phalanx is exposed and mortifies, or till the joint becomes involved. The remedy consists in removing the nail, if loose, with a pair of forceps, dressing the ulcer with an arsenical lotion (liq. potass. arsenit. ʒij. aquæ ℥j.), or with black wash, and attending to the state of the general health.

Syphilitic disease of the nails.

The toe-nails, and sometimes those of the fingers, are affected in constitutional syphilis. There is ulceration beneath the nail as in onychia maligna; but unaccompanied by the peculiar fœtor of that disease, and not attended with so much swelling of the soft parts. There are the cracks between the toes (rhagades) which are so often found in syphilis, and most probably other marks or remains of constitutional syphilis. It is a late symptom, generally in the tertiary stage, and yields rapidly to local mercurial treatment (fumigation or black or yellow wash) and large doses of iodide of potassium.

Psoriasis of the nails.

Psoriasis of the nails occurs either as a syphilitic or spontaneous affection; in the latter case it seems that a parasite like that of ringworm is sometimes present,[2] and it seems sometimes to be caused by the contagion of ringworm. The nail becomes partly separated from the soft parts, and its layers heaped up on each other, like the scales of an oyster shell, much in the same way as the scales of epidermis are heaped up in psoriasis of the skin. It is a troublesome affection, which must be treated, if syphilitic, by a prolonged but mild mercurial course; if non-syphilitic by arsenic. Locally Mr. T. Smith recommends rubbing off the superfluous scales gently with glass or fine sand-paper, or the application of dilute acetic acid, and dressing the margin of the nail at night-time with a mixture of white precipitate and tar ointment.

Ingrowing toe-nail.

Ingrowing toe-nail is a very troublesome affection, and by preventing active exertion, causes inconvenience far out of proportion to its apparent gravity. It occurs from pressure of the toes together, whereby the outer edge of the nail of the great toe becomes embedded in the skin, and this pressure gradually produces ulceration, leading to the formation of a crop of

[1] 'Syst. of Surg.' 3rd ed. vol. ii. p. 962.

[2] Hilton Fagge, in 'Path. Trans.' vol. xxi. p. 407.

irritable and painful granulations at the margin of the ulcerated part. The imbedded portion of the nail is often cut away by the patient or by some one whom he consults; but this is only a palliative, and often not even that, for the pressure still continues to act, and the newly cut edge of the nail is sometimes even more irritating than before.

The principles of treatment are twofold. The most important is to relieve the toes from all pressure by the use of proper boots, or even of an apparatus to disengage the toes and prevent them from compressing each other.

Then the ingrown nail must be disengaged from the flesh. This is effected by raising the buried edge. A little lint is to be tucked in between the nail and the flesh, the centre of the nail being if necessary scraped or notched in order to allow its side to be raised more easily. The irritable granulations are to be repressed by dusting them with the oxide of zinc, or by the use of the nitrate of silver in stick. In many cases the plan of shaving off all the exuberant granulations and other parts down to below the level of the ingrowing nail is successful—care being taken not to allow the granulations from the incision to become again exuberant.

Avulsion of the nail.

Finally, there are many cases where the removal of the nail, though, I believe, it is never actually necessary, is very expedient. For though, no doubt, by dexterity and patience the complaint can always be cured, yet the patient will be deprived of the power of active exercise for a long time, so that in severe or long-standing cases it appears on the whole better to remove the nail under anæsthesia. The sharp point of a strong pair of scissors being driven beneath the middle of the nail down to its root, each half is torn out with a stout pair of forceps. In a day or two the patient can walk about, the sore being protected with a little cotton-wool to prevent the friction of the shoe, and the granulations will have disappeared before the nail grows again.

CHAPTER XLIV.

MINOR AND OPERATIVE SURGERY.

MINOR SURGERY.

THE subject of minor surgery will comprise bandaging, the making of splints, sutures and their application, counter-irritation and cauteries, blood-letting and vaccination.

Bandaging.

The essence of success in bandaging is to apply the bandage so as to cover the whole surface with it, and to make equable pressure over the whole sufficient for the purpose in hand, but never so severe as to produce œdema of the part below, still less to cause sloughing of the skin. A bandage is made, usually of linen or calico, but for some purposes flannel is more convenient, and occasionally elastic webbing may be used, though this requires more care in its application, since, if it is stretched too much whilst it is applied, its recoil may easily produce more pressure than is safe. The bandage is generally rolled up into a single roller (Fig. 393), sometimes into a double-headed roller (Fig. 397), the bandage being rolled up from both ends to the middle.

Bandages are spoken of as simple or continuous and compound. The continuous bandages are best exemplified by those of the leg and arm (Figs. 393, 394). These bandages, which are carried continuously up the limb are thence called 'spiral.' In consequence of the increase in thickness of the limb upwards the bandage if simply rolled round would be quite loose and soon fall off. It is necessary, as shown in the figures, to *reverse* the bandage, by laying a finger on its centre while the bandage is turned round on itself, till a part of the limb is reached which is cylindrical, when the reverses are no longer needed. Each turn of the bandage should lie half over the one below it, and when the whole is completed the bandage should lie quite evenly without any pucker, with the reverses forming a continuous line up the limb. In bandaging the leg (Fig. 393) a turn of the bandage is first taken from the ankle to the foot and back again, like a figure of 8, to afford a hold for the bandage, and then the bandage is carried as far over the foot as necessary. If it is required to include the heel this may be done by a turn carried from the ball of the great toe over the heel, and secured by circular turns round the foot. In bandaging the arm (Fig. 394) an excellent hold is afforded by the thumb. The bandage commences over the wrist, turns round the palm of the hand, through the cleft between the thumb and index finger, makes as many turns round the hand as is necessary to secure any dressing which may be applied there, and then passes spirally up the limb, being reversed as may be necessary.

Spiral bandages.

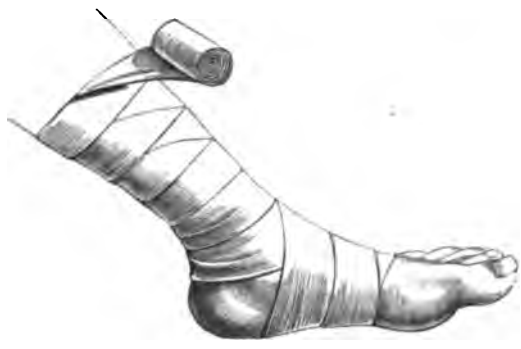


FIG. 393. The common leg bandage.

In bandaging the chest, it is often necessary, as mentioned at page 198, to reverse the bandage, and a brace or support should always be applied.

When the flexures of the joints, knee, groin, elbow, or shoulder are reached, it is no longer possible, even by means of reverses, to apply the bandage continuously, so as to make equable pressure. Either the figure-of-8 bandage must be employed, or a special bandage contrived.



FIG. 394. Bandage for the arm and forearm.

Figure-of-8 or spica bandage.

The figure-of-8 bandage is best exemplified by the spica bandage, which is used to secure the dressings after an operation for hernia, or a poultice to a bubo. One or two turns are first taken round the thigh to afford a hold. Thence the bandage is carried to the iliac crest on the same side, and across the back to the opposite ilium, returns across the groin, and is carried round in this figure-of-8 fashion as often as necessary, being finished off and fixed by a circular turn or two round the abdomen. It is a useful precaution to tack the bandage together at the crossings. The knee or shoulder may also be included in numerous turns of a figure-of-8 bandage gradually converging as they cross, or a very convenient bandage may be made as in the figure (Fig. 396) by tearing an oblong piece of calico or linen down the middle at either end till a square undivided piece is left in the middle. To avoid further tearing, a stitch is put at the end of each tear and knotted. Then the square part is applied over the projecting part of the joint, and the tails are crossed over each other and tied, the lower ends at the upper, the upper ends at the lower side of the joint.



FIG. 395. Spica bandage.

Four-tailed bandage.

The figure-of-8 bandage is also very commonly used in fracture of the clavicle, the crossing being made between the scapulæ.



FIG. 396. Four-tailed bandage for the knee.

Double-headed roller.

Capelline bandage.

The double-headed roller bandage is used when it is necessary to secure the turns of one of the heads of the roller by crossing the other over it, as in the 'capelline' or scalp bandage represented in Fig. 397. The centre of the bandage between the two rollers is laid on the occiput, and when the rollers meet on the forehead, they are crossed one under the other, and the first is turned vertically over the scalp, while the second pursues its horizontal direction. Starting again over the occiput, the two bandages are changed into opposite hands

and the first is brought back again across the vertex to the forehead, half-covering its former turn, and so on. When it has become nearly horizontal the second roller is taken vertically across, and is managed in the same way, and thus the whole head is covered with an evenly-pressing cap of bandage. This is a very efficient bandage when pressure is required over a number of different parts of the scalp. When only a single point requires compression, as in bleeding from one artery, the central part of the bandage is laid on the compress which secures that vessel; then the ends are passed horizontally around the head, or vertically round the head and chin as may be most convenient; then crossed over each other and turned at right angles to their former direction, and so on until sufficient pressure is made, when they may be firmly tied together over the compress and secured to it by stitches. Stitches may also be placed at the crossings of the bandages to make all secure.



FIG. 397. Scalp or Capelline bandage.

The T-bandage is used for the perinæum, in order to secure catheters, to support a pad put on the anus in prolapse of the bowel, poultices in the perinæum, and other dressings in this region. The figure represents one made expressly. A belt passes around the abdomen, above the iliac spine. To this is attached, in the middle line behind, a vertical piece which is divided into two at the sacrum, and the two ends are brought up on either side in front and secured through a loop on the horizontal belt. In practice this apparatus is usually made impromptu, out of two pieces of bandage or thick tapes. Care must be taken to place a stitch where the vertical tape is split behind to prevent its tearing, since that would loosen the whole bandage. In tying in a catheter, it is usual to secure the end of the instrument by tying a double ligature on it with a clove-hitch, so that there are two ends in front and two behind. The anterior ends are tied to the horizontal piece or to the ascending pieces not far from it, and the posterior ends to the ascending pieces near the ischial tuberosities, both being left just slack enough to allow the catheter a little motion as the patient changes his position, but not so much as to allow the end to pass out of the bladder. In applying the T-bandage to a female the vertical piece may be made single if it is required to make pressure on the vulva, being unpinned when the patient wants to make water.

T-bandage.

Securing a catheter.

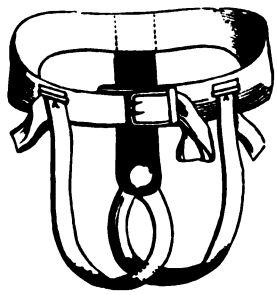


FIG. 398. T-bandage.

The suspensory bandage supports the testicles. It is best procured ready-made from the instrument-maker. When one is not at hand a bandage is passed horizontally round the abdomen, the testicles are included in the centre of a handkerchief the anterior ends of which are passed beneath the bandage, brought down and tied to each other in front, while the posterior ends are also crossed under the bandage and tied below the penis; or the

Suspensory bandage.

handkerchief is folded into a triangle, the apex backwards, its base is pinned or stitched to the band up in front, and its point brought forwards and pinned to the bandage. In this way the scrotum can be raised to the level of the front of the thighs.

The many-tailed bandage.

The many-tailed bandage, or 24-tailed bandage as it used to be called, is now rarely employed. It is made on a foundation of a single strip of bandage or cloth, which is laid along the limb to which it is to be applied on its posterior aspect. To this foundation a number of strips of bandage have been sewn at right angles from above downwards, each overlapping the former by about half its width, the strips being about half as long as the circumference of the limb. The lowest (most superficial) is first drawn tight, then covered by the next one, and so on. The limb is thus bandaged evenly, as if by the spiral roller. The whole apparatus can be withdrawn by loosening the transverse strips from above downwards, and drawing the whole away, behind the limb. A fresh one can then be slipped under the limb, and the bandage renewed, without disturbing the patient at all. The foundation piece is sometimes omitted, but then the bandage is not so secure, nor can such firm pressure be made with it.

Splints.

Closely connected with the subject of bandages is that of splints, or immovable apparatus. The permanent wooden splints used in fractures are generally bought ready-made from the instrument-makers, though the surgeon should always be prepared to fashion them for himself on an emergency. A useful form for country practice is what is called 'Gooch's splint,' composed of thin strips of light wood, bound together with a webbing. This is solid enough to give support in most fractures, easily moulds itself to the convexities of the limb, and can be readily cut by the surgeon with a stout sharp knife to such lengths and shapes as the case before him requires.

The ordinary forms of immovable apparatus are made of bandages, or cloths applied to the limb and either stiffened with some composition, or lined with leather, pasteboard, guttapercha, or some such malleable material.

Starch bandage.

The simplest of all these is the starch bandage, which is usually applied over the pasteboard splint, or may be used by itself, a layer of wadding or soft cloth being between it and the limb. It consists merely of a common roller which is soaked in thick starch after it has been applied, the limb being kept perfectly at rest till the starch is dry.

Gum-and-chalk bandages.

Gum-and-chalk is stouter than this, but cracks more readily. It is made of mucilage, thickened by chalk, rubbed up with it to the consistence of thick cream. In applying these substances they should be freely smeared into the bandage by the hand or a coarse brush in the direction of the turns of the roller, and they may be made thicker by applying another bandage over the first.

Other immovable apparatus.

Many other substances have been introduced for making splints, such as paraffin, silicate of potash, and glue. The paraffin seems to be in every way inferior to starch or gum; the silicate of potash is light and firm but not very strong. As a covering for a plaster of Paris bandage it is often very useful. Glue makes a very good splint if the best French glue can be got; but lately this has seemed difficult. About one-fourth of its bulk of methylated spirit is added to the melted glue, and when the splint is hardened it is cut down the middle, and a series of eyelets let into holes which are punched in it, and it is then laced. The splint is not so solid as that of plaster of Paris, or pasteboard, but it possesses the recommendation that it can be taken off and put on as easily as a laced boot.

The pasteboard splint is an excellent one; in fact, after trying all the

modern substitutes for it, I see little advantage in any of them, for ordinary cases of fracture, over this old one. Pieces of pasteboard are cut to a pattern which shall embrace the limb, the pattern being generally cut out of an old newspaper. They are then soaked in warm water for a sufficient time. When quite flexible they are rapidly moulded to the limb, their edges are trimmed off with the fingers, and they are bandaged on. After the pasteboard is quite dry the outer bandage is starched. Pasteboard splint.

A leather splint is still more secure than one of pasteboard, since it cannot crack; but it is more costly, and a little more troublesome to make. A pattern is taken as before, the leather soaked in warm water till quite soft, moulded, trimmed with stout scissors, and finished as the pasteboard splint. Guttapercha is more easily moulded, is much cheaper, and requires only dipping in nearly boiling water for a very short time to soften, but it has the great disadvantage of being impermeable to the perspiration. Leather and guttapercha splint

The great advantage over all these of the plaster of Paris splint for certain emergencies is the rapidity with which it hardens; against which must be set the disadvantage that it is more difficult of removal, and cannot be re-applied or modified as the others can, if swelling occurs, or if for any cause it becomes desirable to examine the limb. The ordinary splint, therefore, appears better for most cases. On the other hand, it is easy to cut a hole in the plaster splint to expose the wound of a compound fracture or operation, and for such cases it is now in extensive use. It is thus made. One or two rollers of open material are charged with dry plaster of Paris by rubbing in as much as the bandage will hold.[1] The surgeon has a bag of plaster and a basin of water ready. The usual layer of wadding or cotton-wool being applied, the bandage is placed in the water for a very short time, and is then applied, water being washed over each turn as it goes on, and fresh plaster being rubbed over it, as much as required. Two layers of bandage well plastered will make a good splint, the exterior of which can be smoothed and varnished with paraffin or covered with a layer of silicate. In order to expose a wound its position should be marked with a thick wad of cotton-wool, and then the plaster can be dissolved with acid in that part and picked away till the wad is entirely exposed. If the plaster is good the bandage will have set in a quarter of an hour, and the patient can then be removed—a great desideratum in military practice. Mr. Bryant speaks highly of the Bavarian splint, which is certainly easily applied, but is rough and fits far less well than the plaster splint made with the bandage as aforesaid. Two pieces of oblong flannel are sewn together down the middle. The upper (or inner) one is swathed round the limb, well charged with plaster of Paris paste and crossed by the outer one, which is pressed into the plaster and secured with one or two straps, or bandages. The splint is easily removed by tearing the edges of the flannel asunder, the stitching of the two pieces behind acting as a hinge. Plaster of Paris splint.

The most convenient of all these apparatus is that made of Hides's patent felt. The splint is made of felt lined with soft leather, and is hardened by a preparation sold with the felt and put on with a brush, but it is too costly for general use. The poro-plastic felt now in extensive use is made in the same way.

All these immovable apparatus should have a layer of cotton-wool between the splint and the limb. They are removed with 'Seutin's scissors,' or with

[1] In some parts of the body it may be better to make the splint of pieces of muslin or any open tissue similarly charged with plaster and cut to the shape of the part.

a thick, strong pair of common scissors. Some place a piece of tape under the splint before it is made, which serves to pull it up and afford a space for the scissors. Those which are at all elastic may be altered in size by being cut up the middle and laced on again, or their halves joined together with a fresh piece of gummed bandage.

Sutures. Sutures are made of silk, silver, catgut, hair, and occasionally of other substances. Silver or wire sutures have the great advantage of causing the least possible irritation, since they do not imbibe moisture or putrefy; but they are not supple enough for the more complicated forms of suture. It is sometimes said that silver sutures do not cut. But that is true only when they have no tension upon them. If tied too tight at first, or if the parts swell afterwards, all sutures will and must cut the tissues, and silver, I think, cut faster than others, as being more rigid. Catgut sutures are very little irritating, and they require no removal, since they melt away with the heat of the parts, leaving the knot to drop off in the course of about a week. For

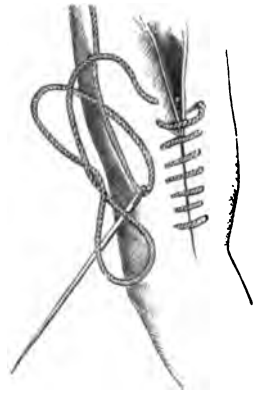


FIG. 399. The continuous suture.

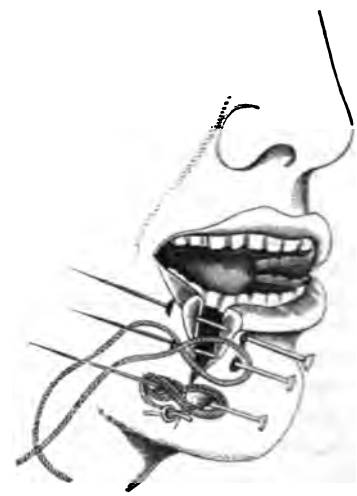


FIG. 400. The twisted suture.

the same reason they are inappropriate for sutures which must be long retained. Horsehair is very pliant, makes very little mark, does not absorb moisture, and may be retained any length of time, but it is difficult to tie, brittle, and too delicate to bear any strain. On the whole silk remains the most universally useful suture.

The forms of suture are as follows:—

1. The *interrupted*, in which each stitch is knotted as it is made. If silver is used the stitches are fixed by crossing each end perpendicularly across the other, and twisting them two or three times. The knot should lie on one side of the line of wound.

2. The *continuous* or glover's suture (Fig. 399) is the suture generally used in the post-mortem room. In applying this to the intestine (which is the part generally sewn up with this suture in the living body) the first knot is passed inside the bowel, and the suture is finished off with a knot as small and lying as close to the coat of the bowel as possible.

3. The *twisted* suture (Fig. 400) is made with a pin, around which the suture is wound in the form of a figure of 8. It is chiefly used in harelip and

in wounds made in removing cancer of the lip. When several pins are used the suture can be finished off separately on each pin (as shown in the figure) or, as is more common, one long piece of silk is used, which is carried on from one pin to the next. The former plan has the recommendation that each pin can be separately withdrawn, but it takes longer to make the suture.

4. The *quilled* suture is used almost exclusively in the operation for rupture of the perinæum, and will be found described on p. 875 with that operation. It may also be required in some very deep wounds, in order to prevent the bagging of matter into their cavity, by keeping the deep parts together.

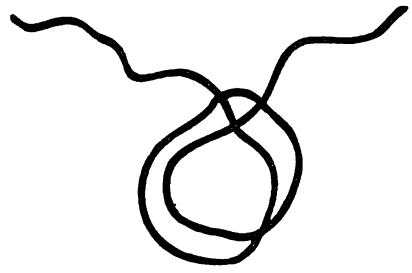


Fig. 401. Clove-hitch.

Clove-hitch.

For tying a string or towel securely on to anything which it is intended to fix so firmly that it shall resist traction (as the jack-towel or strap with which extension is made in dislocation, or the string by which a catheter is tied in the bladder) the clove-hitch is useful. Here the string is made into two loops, and the ends of the second loop are passed through the first in the manner represented in the figure. If the hitch is properly made traction on the ends only fixes the loops more firmly.

Counter-irritants and cauteries.

Blisters are the commonest form of counter-irritation, and are most commonly made of the Spanish fly, either in the form of the common blister, the blistering-fluid, or the blistering-paper. For mere stimulation (rubefacients) mustard is almost universally employed. The method of employing these substances belongs more to treatises on Medicine. When instantaneous vesication is required it can be obtained by applying lint steeped in chloroform to the skin, covered with a watch-glass, or by liquor ammoniæ, or by the transient application of a hot iron; but the latter is not a very safe form of vesicant, for if left on too long it might produce sloughing.[1] There are few cases in which there is any real necessity for more rapid blistering than cantharides will produce, and in these chloroform can be employed. When the blister has fully risen, the serum is to be let out by pricking it and a little cooling ointment applied, unless it is desired to keep up the discharge, when the cuticle must be cut all round, left to cover the raw surface, and covered with ung. sabinæ, or ceratum cantharidis, or blue ointment.

More potent counter-irritation is produced by the croton oil liniment or the tartar emetic ointment, which bring out a crop of pustules over the whole part to which they are applied.

Issues.

Issues are now much more rarely employed than was the case formerly, but their beneficial influence in some of the severer cases of joint-disease seems to me indubitable. They are now, I believe, always made with caustic potash, either pure or in the form of the Vienna paste, a mixture of 5 parts of caustic potash with 6 parts of quicklime. A piece of plaister with a hole corresponding to the size of the proposed issue is applied, the hole filled with the caustic, and covered with cotton-wool or lint and strapping. When the

[1] A 'thermal hammer' was in use some time ago bearing the name of Dr. Corrigan. It was prescribed to be immersed in water at 120° F. and held in contact with the skin for two or three seconds as a rubefacient and for 5–10 seconds as a vesicant.

skin is thoroughly destroyed a poultice hastens its separation, and the ulcer is kept from healing by occasionally touching its edges with caustic potash. This is less painful and inconvenient than the old plan of bandaging peas on the sore. The slough resulting will be about twice the size of the hole in the plaister.

Moxa. Mr. T. Smith speaks of establishing issues by means of the moxa, but I have never seen this done, and, indeed, I have scarcely seen the moxa used for many years. It is a very painful application, which used to be employed either as a counter-irritant or a cautery. A piece of lighted German tinder was placed on a frame, and the flame directed to the skin by means of a blow-pipe. The utility of the method is hardly so indubitable as to justify such a barbarous proceeding. I remember, however, once seeing it work as instantaneous a cure in a case of hysterical paraplegia as 'Duke Humphry's miracle' in Shakespeare's play.

Setons. Setons also, as counter-irritants, are becoming rapidly things of the past. They are made by pinching up a large fold of skin and passing a skein of silk threads underneath it through the cellular tissue above the deep fascia. For this purpose a needle of peculiar construction, with a very large eye, is convenient. If this is not at hand a straight knife must be passed in the track of the seton, and the silk conveyed along it by means of an eyed probe before the knife is withdrawn. The skein of silk is loosely knotted, and should be moved a little each day backwards and forwards as soon as suppuration has commenced. When used to empty abscesses or cysts one or two threads run through with a common needle will suffice.

Actual cauteries. Cauteries are divided into actual and potential. The actual cautery is sometimes used as a counter-irritant, in which respect it is of the most signal service in painful affections of the joints, a white-hot iron, shaped like a hatchet, being drawn rapidly in cross lines over the skin of the part, so as just to scorch the epidermis and possibly produce very superficial sloughs. When used as a hæmostatic the cautery should be broader and should be kept longer in contact with the tissues, but not so long as to stick to them and pull them off. Some surgeons prefer to use the iron at a dull red heat for this purpose. In destroying morbid growths, for which purpose, however, it is generally inferior to the potential cauteries, it should be applied very lightly at first, and then others should be applied more deeply till the parts are as thoroughly charred as possible.

Galvanic cautery. The galvanic cautery has the great advantage that its heat is renewed as fast as it is lost, but, of course, it can only be applied over a very small surface. Its chief use is in cutting through vascular parts, such as the tongue or the base of a pile, and it is used also for destroying the walls of sinuses and producing a healing surface. Many ingenious apparatus have been constructed for applying this form of cautery in various operations, based on the cautery of Middeldorpff, but it would be out of place to describe them here.

Benzoline cautery. A most manageable and ingenious cautery has been recently introduced, called the Benzoline or Paquelin's cautery. It consists of a Richardson's spray-producer communicating with a hollow stalk which terminates in a double plate of platinum, so that the vapour of the benzoline passes between the laminæ of platinum, which are bent into the shape required for the cautery. The platinum is placed in a spirit lamp, and then as the vapour passes between the heated surfaces it ignites, and by increasing the stream of vapour the metal can be raised to a white heat in a very short time, or

by diminishing the stream the heat can be reduced as required. The burnt vapour escapes from holes in the lower part of the stem.

Potential cauteries.

The potential cauteries are substances which enter into rapid chemical combination with the tissues of the skin or other parts, chiefly by withdrawing its fluid element from it, and so disintegrating the part to which they are applied. The chief substances in use are as follows: Sulphate of copper, which is used chiefly in the form of blue lint—i.e. lint steeped in a saturated solution of the salt. This is a useful hæmostatic, and produces a superficial slough of the exposed parts to which it is applied. Sulphate of zinc in the form of powder, or made into a paste with glycerine, is a useful caustic in warts, condylomata, and growths about the female urethra, according to Sir J. Simpson. I have seen these growths treated more frequently with the fluid caustics, of which acid nitrate of mercury and nitric acid are the most manageable and the handiest. Sulphuric acid also made into a sort of paste with sawdust or asbestos is a very efficacious and a very painless caustic. Arsenical paste, the formula for which is given on p. 911, is recommended by many writers on skin-diseases as more efficacious for stopping the spread of destructive ulceration than any other, but there is no question that its use is by no means free from danger, and that fatal results have occasionally followed.[1]

The most universally serviceable of the potential cauteries are the chloride of zinc and the potassa fusa. The former is disguised in various ways by quacks and sold as a nostrum. It may be used pure—rubbed on to the parts in stick, or mixed with flour or plaster of Paris into a paste, or made into sticks or pencils with flour, which are stuck like arrowheads into the substance of the growth to be destroyed. This is the plan of 'Cauterisation en flèches' of M. Maisonneuve, and it is an admirable method of removing morbid masses below the skin—e.g. enlarged glands. The patient being narcotised if it is thought necessary, a knife is passed deeply into the growth and the arrow of caustic inserted. This is done in several places, the caustic arrows cut close to the skin and left in. A dose or a subcutaneous injection of morphia will dull to a certain extent the severe pain which follows for some hours. Then the skin turns a dead white. A poultice is applied, and in a few days a mass shells out something like a billiard ball, exposing a surface which if healthy will cicatrise, and if not may be treated with renewed applications of the caustic. Another way of applying the chloride is by producing a superficial slough, and then scoring it, and stuffing the incision with the caustic. Potassa fusa is applied pure, or as Vienna paste, and is also a most excellent caustic.

'Cauterisation en flèches.'

The pain of the cautery is somewhat dulled by the application immediately afterwards of some substance which will decompose it, as chalk for the mineral acids, and vinegar for caustic potash; and their action is limited to the part which is to be destroyed, by smearing those in the neighbourhood with oil or covering them with a ring plaster.

Blood-letting.

Blood-letting is either general—venæsection and arteriotomy—or local—leeching and cupping.

Arteriotomy.

Arteriotomy is now, I think, given up; at least, I never saw it practised

[1] 'In the practice of M. Roux the application during a single night of a paste containing 4 per cent. of arsenic to a surface of little more than an inch in diameter proved fatal.'—'Syst. of Surg.' 3rd ed. vol. ii. p. 651.

but once. If anyone should choose to open the anterior branch of the temporal artery no special directions would be necessary. The vessel lies close under the skin, and all that is required is to touch it with the point of a lancet. When the required quantity of blood is obtained, the puncture may be closed with compress and bandage, or the artery cut across.

Venæsection.

But the only method of general blood-letting now in use is venæsection at the bend of the elbow. A bandage is tied round the arm tight enough to make the veins of the forearm start out. Then the more prominent of the two veins at the bend of the elbow is selected. This is usually the median basilic, which has the further great recommendation that it is firmly supported by the bicipital fascia, and will not retract from the lancet. The surgeon should assure himself previously that there is no abnormal artery coursing below the skin, and that he is away from the position of the brachial. He then steadies the vein with his left thumb while he dips the lancet into it, and lets the lancet cut itself out by describing a circle with it, thus making a free incision which lies rather obliquely to the axis of the vein. The patient can increase the flow of blood by grasping a stick or a piece of bandage and working his fingers upon it. When as much blood as is desired has been obtained, the wound in the vein is closed with the thumb, the arm-bandage unloosed, a compress of lint

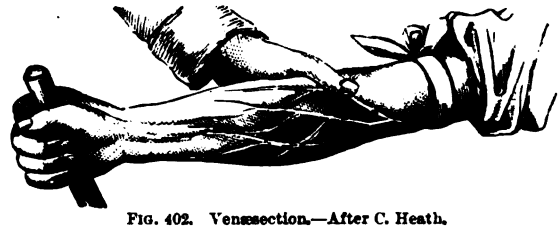


Fig. 402. Venæsection.—After C. Heath.

applied, and bound on the wound by the arm-bandage arranged in a figure of 8. A wound of the brachial artery has often been caused by want of skill in this little operation, and very often has been successfully treated by firm compression. If the arterial wound does not heal and a varicose aneurism forms, it must be treated on the principles explained on p. 582.

Cupping.

Leeching need not be here spoken of, and cupping also is now seldom prescribed; still it is a very useful measure in many cases, and I cannot think that its present neglect will be permanent. At any rate, a surgeon ought to know how to cup if required. The operation is done with a scarificator, which is a box containing a spring to which are attached a number of lancet-blades in two parallel rows, so set that when the spring is drawn up and the bottom of the box laid on the skin, by touching the spring the blades are released, and as they pass through the slits made for them in the bottom of the box they project out of the slits and so cut the skin, making a number of scarifications or small incisions through it just into the cellular tissue.[1] Then the surgeon takes one of the cups and puts the 'torch'—a wick steeped in spirit—into the cup so as to exhaust it, and claps it rapidly over the scarifications. The cups are graduated in order to mark the quantity of blood drawn, and the given quantity is obtained by renewing the cups, which, however, should never be put on in exactly the same line. The depth of the incisions can be regulated in setting the spring according to the thickness of the skin about to be operated on. Dexterity in cupping can only be

[1] The incisions ought not to be too deep, otherwise the subcutaneous fat may be squeezed out and so plug the cuts as to prevent bleeding.

acquired by constant practice and attention to a number of small details which it seems hardly worth while to describe here, but which are soon learnt by experience.

Vaccination consists in the insertion below the cuticle of the matter from the cowpox, so as to produce that disease in the person vaccinated, the vaccine lymph being absorbed by the vessels of the cutis vera. The first object of the vaccinator is to bring the lymph into proper contact with the vessels of the skin without drawing any blood, or as little as possible. To this end the skin is stretched tight, the cuticle is gently raised by inserting the lancet-point obliquely through it, and the lymph is then introduced. Numerous contrivances have been devised for vaccination. The lancet may have a groove in it which is filled with lymph before its introduction, or after the puncture is made may be charged by dipping it into the lymph, then again inserted into the puncture, and the lymph squeezed off by pressing the edges of the puncture together, or an ivory or quill point may be used instead of the lancet for this latter purpose. Instead of the lancet puncture, scratches may be made through the cuticle, into which the lymph is rubbed, or the cuticle may be raised by a minute blister, and when this is pricked it may be filled with lymph, as Mr. Ellis recommends; or the cuticle may be entirely scratched off the part to which the vaccine is to be applied. The lymph also is procured from the vaccinifer in many different ways. The one now most in use is to charge capillary glass tubes with it, seal them up, and preserve them for use, when the ends are broken off and the lymph blown out of them on to the lancet. It is more satisfactory, however, to take the lymph fresh from the arm of an infant who has been successfully vaccinated and use it the moment it is drawn, and perhaps more satisfactory still to obtain it fresh from the calf. Another method, but a less secure one, is to charge ivory points with it and allow them to dry, moistening them in steam before using them; or to preserve it dry between two plates of glass. Vaccination.

The result of primary successful vaccination is stated in the instructions to public vaccinators to be as follows:—

'The puncture may be felt slightly elevated on the second day; on the third it is surrounded by a slight halo of redness; by the fifth a distinct vesicle will be formed, having a slightly elevated margin and a depressed centre; on the eighth day the vesicle should have reached its perfect condition, when it is pearl-coloured and distended with clear lymph, its margin being tinged, firm, and shining.[1] From this period the redness around increases in extent and intensity until the tenth day, when there is often well-marked swelling and induration of the subjacent cellular tissue. On the eleventh day the areola begins to subside, leaving as it fades two or three concentric rings of redness, the vesicle begins to dry up, assuming a brownish colour, the remaining lymph becomes opaque, and generally concretes, forming by the fourteenth or fifteenth day a dry reddish-brown scab; this contracts, dries, blackens, and finally falls off about the twenty-first day. The resulting cicatrix is permanent, slightly depressed, dotted, or minutely pitted.'

Secondary vaccination, or the vaccination of persons who have been vaccinated before, sometimes gives results identical with these, or differing only very slightly from them, showing that the subjects were in no respect protected by the previous vaccination, although probably if they had contracted small-pox the disease would have been milder. But it is more common for the Secondary vaccination.

[1] It is at this period that the lymph should be taken from the vesicle for use in vaccination.

results to be variously modified, and sometimes severe inflammation of the glands and absorbents is produced.

It is always usual to vaccinate in three different spots about an inch distant from each other, and some believe that the protection is more complete when this is done in both arms—i.e. when the patient is vaccinated in six places at once.

OPERATIVE SURGERY. ANÆSTHETICS.

THE subject of Operative Surgery, considered in itself apart from the questions of the diagnosis of the disease or lesion, the indications for the operation, and the previous and subsequent management of the patient, comprises the three following topics:—(1) the administration of anæsthetics, (2) the arrangements for the prevention of hæmorrhage, and (3) the operative manipulations.

The administration of anæsthetics has now been developed almost into a special branch of practice in large cities; and the custom is a convenient one, as it permits the surgeon to attend to the details of the operation exclusively, though it cannot be said to be necessary, since every surgeon who can trust himself to operate must be competent to superintend, and if necessary to administer the anæsthetic.

Anæsthetics are divided into *local*, or those which merely benumb the part to which they are applied, and *general*, or those which abolish the sensation of the whole system. The latter are of universal, the former only of very limited utility. We will speak first of local anæsthesia.

Local anæsthetics.

The local anæsthetics at present in use are a freezing mixture of ice and salt and the pulverised vapour of ether, and in both of them the rapid action of extreme cold is the agency employed for abolishing the cutaneous sensation. This it does so rapidly that there is no necessity for continuing the action of the cold for any length of time. The skin turns of a dead-white colour and becomes somewhat puffy, and may then be cut, cauterised, or otherwise treated without any sensation on the part of the patient. This insensibility lasts for a few minutes, after which the circulation and sensation return. No pain accompanies either the freezing or the thawing.

The mixture of ice and salt is more convenient when the anæsthesia has to be distributed over a considerable surface, the ether-spray when it is to be limited to a small portion of skin or to the line of a single incision. In the former—introduced into practice by Dr. J. Arnott[1]—a quantity of rough ice is pounded into pieces, none of which should be larger than a nut, and rapidly mixed with as much salt. The pounded mixture is then put into a bag of rough muslin (so that the brine may run off as it is formed), and is laid closely round the skin which is to be frozen. After about four minutes the characteristic appearance of the skin will show that the desired effect has been produced. The application of the vapour of ether as an anæsthetic was first suggested by a Dr. Guérard,[2] and has been applied by Dr. Richardson by means of the spray-producer, which is modelled on the instrument originally invented for pulverising the vapour of essences. The ether should be pure, or washed; and the direction of its vapour to the spot or the line chosen for the incision during a very brief period will produce such intense cold as to render the skin quite insensible.

The great objection to local anæsthesia is the very limited extent to which

[1] 'Lancet,' Oct. 30, 1858.

[2] Trousseau et Pidoux, 'Thérapeutique,' 8th ed. vol. ii. p. 349.

it reaches. It can only be applied to the very surface of the body, and only extends to the part which is actually frozen, the parts around being rather more sensitive than natural. It has been apprehended that the frozen parts would be liable to slough, but I never saw any foundation for this apprehension.

Ether and chloroform.

The general anæsthetics which are in most common use are ether and chloroform. After the first discovery of anæsthesia by the inhalation of ether, by the American dentists Morton or Wells, the details of the novel method were, of course, somewhat uncertain, and the administration was attended with some difficulty, which resulted chiefly from the surgeon not trusting to the ether sufficiently, and administering it too gradually. I do not know that I can do better than quote a letter from Mr. Warrington Haward in the 'Brit. Med. Jour.' Aug. 14, 1875, which gives in a short space all the precautions necessary for the administration of this anæsthetic, to which I need only add that in this as in all other anæsthetics it is very desirable to have the stomach empty—i.e. to enforce abstinence from food for about four hours whenever it is possible. On an emergency, however, this is of no great importance, but the patient will probably be troubled with vomiting during and after the operation.

Administration of ether.

'For the safe and efficient administration of ether-vapour for producing anæsthesia, several things are needful to be known and remembered, which are chiefly these:—

'1. That kind of ether should be used which is fittest for the purpose of inhalation, and this is the pure anhydrous washed ether, of specific gravity ·720, free from alcohol and water. Robbins' "ether for local anæsthesia" is a dangerous compound for inhalation.

'2. The ether should be given in such a way that the inhalation may be commenced with a very weak vapour, which, after a few inspirations, can be rapidly increased in strength. If we begin with too powerful a vapour the air-passages are intolerant of it, and the patient resists the inhalation; but after a few moments' inhalation of a weak vapour, its strength can be increased without inconvenience and the patient rapidly brought under its influence. I think a cone of felt, covered with thin mackintosh, is the simplest and best apparatus for this purpose.

'3. Stimulants should not be administered before the inhalation. Ether is itself a stimulant, and can be safely given in cases where there is great depression; but, as Mr. Clover has pointed out, it is very undesirable to have alcohol in the stomach when ether is being inhaled.

'4. Whatever danger may belong to ether has relation to the respiratory function; the breathing should, therefore, be watched. And I may add, it is desirable so to place the head of the patient that the saliva (the secretion of which is increased by the ether) may run out of the corner of the mouth rather than into the trachea.'

A more rapid method of administering ether has now come into extensive use, viz., to make the patient breathe into a closed receptacle between which and the mouthpiece is the vessel for the ether. Thus the patient breathes and re-breathes the same air, charged with ether and of course warmed by his breathing—and thus a certain degree of asphyxia is mixed with the anæsthesia: though when this asphyxia becomes pronounced it is relieved by raising the apparatus from the face during one or two inspirations. The advantage of the method, besides its rapidity, is that the patient, breathing a warmed atmo-

sphere, is not exposed to the danger of rapid bronchial congestion, which sometimes no doubt attends the breathing of so irritating a vapour as ether. Sir J. Lister speaks of this as the 'close' method of giving ether, and says that it has a lowering effect on the circulation, and is on the whole more dangerous than the open method, from failure of the heart's action.

Another favourite plan at the present day, and I think often a convenient one, is to commence by the administration of nitrous oxide, and then maintain the anæsthesia by ether.

Administration of chloroform.

Chloroform is a more potent agent than ether, and takes less time to produce complete anæsthesia. The production of this state is marked by an absence of all voluntary motion and sensation and of reflex motion. As a test of this the eyelid is usually taken, and when the eyeball can be touched without any winking being induced the patient is reported as being fit for operation. The danger of anæsthesia consists in the risk that the poisonous effects thus manifested in the cerebro-spinal axis should extend to the central ganglia which preside over the functions of respiration and circulation, and so either the breathing cease or the heart become paralysed.

The methods of administering chloroform vary. Dr. Snow was led by the experiments he made to believe that 5 per cent. of chloroform in the inspired air is a proportion which could never produce danger, and he contrived an inhaler by means of which a certain surface of blotting-paper charged with chloroform is exposed to the contact of air at a definite temperature, so that the proportion of chloroform vapour could not, as he believed, rise above the limit of safety. Mr. Clover attained the same end more surely by mixing definite quantities of the vapour of chloroform and air in a large bag, carried over the shoulders and attached to the mask which covers the patient's mouth. But Sir J. Lister has, I think, shown satisfactorily that the evaporation from the usual quantity of chloroform poured on to a cloth never, even at high temperatures, rises above 4·5 per cent. (of which, of course, a great part is dissipated into the air),[1] and therefore that the method of administration with the cloth or handkerchief is quite as safe as that by Dr. Snow's inhaler and *à fortiori* by other inhalers, which, in fact, are rather contrivances for economising chloroform than for regulating its dilution. Another advantage in this simple method is that the quantity of chloroform poured on to the handkerchief is a matter of secondary importance, while in Dr. Snow's inhaler it is essential to the mechanism that not more than ʒij. should ever be in the instrument at the same time. About ʒiss.–ʒij. then of the chloroform are to be poured on the handkerchief, and the patient is to be gradually accustomed to the taste and pungency of the vapour by holding it rather far from the face, and giving him occasional breaths of pure air, and when he is getting somewhat intoxicated pressing it rather more. A period of excitement, noise, and struggling usually, but not always, comes on, and then the patient sinks into a slumber, the limbs no longer resist when moved, he does not resent a pinch or prick with the knife, and the eye is insensible. Then the operation may be begun. In the last edition of his essay, Sir J. Lister describes a slightly different method as more convenient, and probably safer, both as producing anæsthesia with a lower percentage of chloroform, and as necessitating more constant attention. This consists in covering the patient's face from the root of the nose to the chin, either with a mask of flannel or with a cap made of the corner of a towel, about nine inches square, and moistening it constantly with small quantities of chloroform. In this way anæsthesia can be produced

[1] See 'Syst. of Surg.' 3rd ed. vol. iii. p. 601, *note*.

and maintained equably for any length of time with about 2½ per cent. (by volume) of chloroform, and this Sir J. Lister holds to be well within the limit of perfect safety, and to constitute an approach to what Paul Bert has spoken of as the 'zone maniable,' i.e. an atmosphere in which the patient might be left for an unlimited time in safety without any attention.[1] Sir J. Lister is a strong advocate of the theory that all that is necessary for safety in chloroform inhalation is to watch the breathing, and when any lividity of the face occurs, or any laryngeal stertor, to pull the tongue out of the mouth with a pair of forceps sufficiently far to open the larynx freely [2] and allow the patient to breathe naturally, withdrawing the cloth till the indications of returning sensibility necessitate the readministration of the vapour. And doubtless these precautions would reduce the mortality after chloroform materially. Still there have been many deaths resulting, as far as we can judge, from sudden failure of the heart's action, under the hands of persons quite aware of the importance of watching the respiration, and whom we have no ground for charging with negligence; and, in fact, Sir J. Lister allows that there may be varying idiosyncrasies in respect of chloroform. The only death from chloroform that I ever happened to witness was in a young man of perfectly healthy appearance, and in whom an experienced chloroformist certainly noticed no obstruction to the respiration before the failure of pulse which proved at once fatal. It seems, therefore, safest to watch both the pulse and the respiration, the latter most narrowly, as it is the side from which the danger most commonly occurs. On the first symptom of failure of the pulse the chloroform must be suspended, if the galvanic battery is at hand it should be applied, and the breast should be well slapped with cold towels, while hot affusion is practised to the head. When the respiration is suspended, if forcible traction on the tongue fails to restore it, artificial respiration should be practised, the tongue being still held forward.

Relative safety of ether and chloroform.

The question of the relative safety of ether and chloroform is one on which I have no wish to dogmatise, but I have used ether with great comfort for many years, and have never seen any but the most trivial inconvenience from it, such as blistering of the lips from evaporation, and cough or irritation of the bronchial tubes from its pungency. During the same time I have also employed chloroform perhaps as commonly, and have been so fortunate as to escape any fatal accident from this in my own practice, and, as I have said above, never to see more than one death from it. But I think we can hardly resist the unanimous opinion of the American surgeons, founded on nearly 80 years of extensive experience, as to the relative safety of ether, and if so we should only employ chloroform in exceptional cases. There are some persons (chiefly old topers) in whom ether produces such excitement, or whose bronchial membrane is so sensitive, that it has to be given up, and with them, if any anæsthetic is used, it should be chloroform. Chloroform seems also perfectly safe in childhood, but so is ether also.[3]

An idea seems still to prevail that anæsthesia is especially dangerous in

[1] For the discussion of this question of the 'zone maniable' I must refer to Sir J. Lister's essay, pp. 615 et seq.

[2] I must refer the reader to Sir J. Lister's article (p. 604) for his theory of the effect on the larynx of drawing forward the tongue, and for his views of the nature and symptoms of laryngeal obstruction. The main point in practice is to recollect that defective breathing comes on very insidiously and suddenly, and may be relieved by forcible traction on the tongue.

[3] The deaths which have been recorded from ether are certainly very few in number. One which occurred a few years ago at Lincoln attracted much attention. The lady was a member

Anæsthetics in heart-disease.

disease of the heart, but I think this is an error. It is true that in extensive disease of the heart any excitement may prove fatal, and so may of course that of taking ether or chloroform. But then the shock of the operation without an anæsthetic is far more likely to cause death in that condition, so that if any operation is required it seems safer to perform it under anæsthesia than without.[1] In themselves both ether and chloroform are stimulants, especially the former.[2]

Bichloride of methylene.

Bichloride of methylene is an anæsthetic which possesses the advantages of producing insensibility very quickly, and of not causing any subsequent sickness or discomfort. The patient also recovers very rapidly from its effects. On account of the immunity from sickness it is much used for ovariotomy; and on account of the rapidity with which persons can be brought under its influence, it is reported to be much used in some eye institutions where many operations are performed. But ether seems, with proper precautions, almost as free from after-vomiting, and the saving of time in producing anæsthesia is a poor reason for employing an agent which seems to be more dangerous than the other anæsthetics.[3]

Nitrous oxide.

Nitrous oxide, or laughing gas, has now been made available for practical purposes by giving it freely and pure, i.e. unmixed with air. In this way it does not excite, but produces at once a condition of complete insensibility. The patient becomes entirely comatose, the whole blood is unoxygenated, so that the surface is of a dark livid colour, and the blood which exudes from an incision quite black. The condition of the patient appears most alarming, but in two or three minutes the colour returns and he recovers, with no symptoms whatever, and no traces of the alarming state in which he has been. During those two or three minutes any operation can be performed with as complete absence of sensation as under any other anæsthetic. And as the administration can be repeated, long operations may be performed without any remembrance on the part of the patient. But it is doubtful whether this would not be as dangerous as any other anæsthetic, and it is certainly much less convenient, so that nitrous oxide is now reserved for very short operations, like tooth-drawing, or other transient but painful proceedings. The gas is stored under pressure in a liquid state, and on the removal of the stopper from the bottle a certain quantity resumes its gaseous condition and fills a bag which is screwed on to the bottle, and contains enough for one administration. The bag is then attached to the mouth-piece.

of a surgeon's household, and the ether was administered by a professional chloroformist. What Sir J. Lister says seems probable enough, that deaths occur from ether, not on the table, but soon afterwards, from rapidly increasing congestion of the lungs, which as they do not occur during the operation escape record as deaths from anæsthesia, though they are so in reality.

[1] I have already alluded to a death which I saw from chloroform in a perfectly healthy person, in whom post-mortem examination detected no visceral disease of any kind. The next patient brought into the operating theatre was one of my own—an old man, with extensive disease of the heart. He was placed under chloroform, and the operation completed without any bad symptoms. A few days afterwards he fell down dead while walking across the ward. —'Path. Trans.' vol. xv. p. 69.

[2] 'An amputation performed under chloroform,' says Sir J. Lister, 'has often the effect of improving instead of lowering the pulse,' and he gives a striking example of this.

[3] I ought not to omit stating, however, that Sir Spencer Wells always uses this anæsthetic, and stated in his lectures at the College of Surgeons that he had never seen the slightest trouble from it.

MEANS OF RESTRAINING HÆMORRHAGE.

HÆMORRHAGE is restrained in amputations, and other operations on the limbs, by the *tourniquet*, a contrivance whereby pressure is made directly on the main artery, and also by means of a circular strap on the whole limb. The common tourniquet consists of a pad which is pressed down by a screw, and the screw is attached to a large strap which encircles the limb, and thus as the screw is pressed down it tightens the strap and makes pressure equally on the limb all round. The pad is either attached to the screw or is placed below it, secured also by a circular webbing-strap, or is replaced by a piece of roller laid on the artery. Care should be taken so to direct the pressure as to compress the artery against the subjacent bone. This is a most efficient method of controlling hæmorrhage, but it produces, of course, considerable venous engorgement, and cannot be tolerated for any length of time. The Italian, Signorini's, or the horse-shoe tourniquet is an arch of metal larger than the limb, having an expanded piece to rest against the side opposite the artery, while a screw carrying a pad is directed against the artery from the opposite end of the arch. This makes no circular compression of the limb, and does not produce venous congestion except by the unavoidable pressure on the main vein accompanying the artery. All the aneurism-compressors are made on this principle, as well as the aortic tourniquet for amputation at the hip.

The common, or Petit's tourniquet.

The horse-shoe tourniquet.

Some surgeons are fond of using finger-pressure on the artery instead of a tourniquet, and this is necessary in many situations, as in amputations performed so high that there is no room for the tourniquet. Whenever the tourniquet can be applied I believe it is much better, as saving the loss of blood. In making digital compression, the assistant who takes charge of the artery should take a sufficient grasp of the limb to steady his thumb, which is to be firmly pressed on the artery in the proper direction, and supported by pressure with the thumb or fingers of the opposite hand. When that thumb gets quite tired the other is to be rapidly substituted for it and supported in the same way. Davy's lever is another method of making pressure on a single vessel. It is described in the section on amputation at the hip.

Digital pressure.

The tourniquet does not render the parts bloodless; in fact, it causes venous congestion; but complete absence of blood in the parts divided may be secured by the application of an elastic bandage as recommended by Prof. Esmarch.[1] A bandage consisting of stout indiarubber tissue is rolled round the limb exactly as a spiral roller is. No great force need be employed, but the constant resilience of the elastic tissue will squeeze the blood out. In order to hinder its return a stout piece of elastic tubing is passed twice round the limb just below the upper edge of the bandage and secured by hooks. Then the bandage is unwound from the limb, which is seen to be perfectly pale and bloodless, and, when cut into, its tissues are as free from blood as in the dead subject. Even the bones are sometimes entirely empty of blood. The benefits of this method are great during any operation in which the oozing from the parts is annoying, i.e. all dissecting operations; and they are also striking in excisions, since the precise limits of the disease can be

Esmarch's bandage.

[1] Esmarch's method of rendering a limb bloodless by the constant pressure of an elastic bandage is altogether different from the long-known method of applying a common bandage before putting on the tourniquet, which was so far from rendering the parts bloodless that it was found hardly worth the trouble of application, and fell out of use.

seen as well as in the post-mortem room. In cases also of traumatic aneurism, of wound of the artery, and of the old operation for aneurism, the method seems applicable. I am not sure that blood is really saved by it, for in many cases the very free oozing which takes place as soon as the circular tube is removed pretty nearly balances what would have escaped if the operation had been performed in the usual way. Riedinger refers to a patient operated on by Linhart for irritable stumps, following double amputation above the malleoli for frost-bite, where secondary amputation was resorted to in each instance; but on the right limb the elastic bandage was applied, while digital compression was adopted when the left stump was removed. The blood lost during and after the operation, before the flaps were approximated, was carefully weighed, and found to be $2\frac{1}{2}$ oz. in the case of the right, and $1\frac{1}{2}$ oz. in that of the left.[1] In regard to the amount of blood lost to the system, however, he says this calculation is not absolutely correct, for in the small stump removed from the left leg there was a very small amount of blood that was not returned to the trunk, by the mere elevation and rubbing employed before digital compression was begun. This could not have been much, however, for the stumps contained but a small amount of blood, and according to Bruns, about thirty per cent. of the blood in an extremity remains after the elastic constriction has been thoroughly applied. I have not seen any prevalence of sloughing after operations so performed, nor have I realised the dangers of pressing the products of suppuration up the veins, or producing internal congestion by squeezing the blood back; in fact I believe them to be imaginary, but further experience is necessary to show us what is the real value of the method. The attempts to show that the mortality after operations so performed is lessened by the method are quite premature. After the constricting band is removed, a few minutes should be allowed for the bleeding to subside under the use of cold water, after all the main vessels have been tied, and with this precaution I have not met with any secondary or recurrent hæmorrhage.

Prof. Esmarch adopts a different method of stopping the oozing which follows the removal of the band. In amputations he unites the wound by deep sutures of catgut, places a drainage-tube in the deepest part of the cavity, applies 'a retentive dressing,' and places the limb in a vertical position, before removing the band. The stump is then kept vertical for half an hour after the patient has been put back in bed. A slight modification of the same plan is used in excisions and other operations.—'Lond. Med. Rec.' Nov. 15, 1880.

We have now to treat of the strictly manipulative part of operative surgery. All the surgical operations, however, which are employed only in special parts of the body have been spoken of above in their appropriate places, as lithotomy with diseases of the urinary organs, tracheotomy with those of the larynx, &c. It remains to speak of plastic surgery, amputations, and excisions.

PLASTIC SURGERY.

The operations of plastic surgery are directed to filling up the gaps left by destruction of the nose, and by the incisions made in dividing or excising

[1] 'Deutsche Zeitschrift für Chirur.' VII. p. 466. In the same paper an ingenious speculation as to the possibility of staying the hæmorrhage by galvanism will be found. See also a paper by Dr. Roberts of Philadelphia in 'New York Arch. of Clin. Surg.' vol. i. p. 176.

cicatrices, or in refreshing the edges of unnatural clefts. Some of these operations, especially those of the latter class, have been spoken of in previous pages. Such are the operations for harelip, fissured palate, and ruptured perinæum. The principle of this class of plastic operations is to bring the edges of the cleft into apposition by means of some form of suture and obviate tension, if necessary, by incisions. Incisions, however, are not always necessary. Thus, in harelip, no incisions are, as a general rule, required. If any are so they are made along the border of the nose. In fissure of the soft palate the object of the incisions is chiefly to divide the muscles, while in that of the hard palate free lateral incisions are made through the muco-periosteal structures. In ruptured perinæum and in recto-vaginal fistula incisions are usually superfluous, but sometimes the sphincter may require division. In vesico-vaginal fistula it is generally impossible to place incisions so as to give any assistance to the sutures, but occasionally such incisions may be made through cicatrices in the wall of the vagina.

Lateral incisions in plastic operations.

The operations for restoring the nose and for contracted cicatrix involve the process of transplantation of skin,[1] which is rarely required in the operations for the closure of fistulæ. Up to the present time I think it may be said with truth that nothing except the skin has been successfully transplanted; but attempts are being made to transplant periosteum which may form the nidus of bone (osteoplasty), and if such attempts succeed they might much extend the practice of plastic surgery, and especially in the operation of nose-making.

Transplantation of skin.

Two ways of transplanting skin are recognised, viz. by displacement or gliding, and by torsion. In the former the piece of skin is dissected up, left attached to the surrounding parts by a broad isthmus, and then its direction is so shifted that it can be fitted into the part where it is intended to lie. The neck, or isthmus, remains permanently, and the puckering or twisting caused by the displacement gradually disappears. In the method by torsion, the position of the flap of skin is entirely changed (for instance, it is brought down from the forehead to the nose), and for this purpose it is left attached by a neck as slender as is consistent with the maintenance of vitality, which neck is twisted so as to permit of an entire change of position. Then the edges of the skin are stitched to those of the cleft, and after a sufficient time, when the transplanted skin has fully received the elements of vitality from the neighbouring parts into which it was transplanted, the neck is divided and that part also of the transplanted flap inserted into the edge of the cleft, so that now the flap is permanently fixed in its novel position. Such transplantation can be effected from one part of the body to another, as from the arm to the nose, or from the thigh to the hand, the parts being kept in apposition by some mechanism until the transplanted flap has grown into the cleft.

By displacement; 'Autoplastic par glissement.'

By torsion. Veritable transplantation.

Recently attempts have been made to transplant bodily portions of skin which have been removed entirely from their natural position. Thus a piece of skin has been dissected out of the arm, or taken from a limb just amputated, and fitted into a bed prepared for it in the face or eyelid. And I believe some of these attempts have succeeded, though the only one which I have seen

[1] These flaps are always spoken of as being formed of skin, but in truth as much as possible of the subcutaneous tissue also should always be taken up along with the skin. The more fat and vessels can be raised with the skin, the less risk is there that the skin will slough.

failed. The skin in such cases is to be cut a little larger than the gap which it is to fill, carefully freed from all fat and cellular tissue, shaped as rapidly as possible to the gap, and united by a number of fine sutures. It must then be covered up warm, and left quietly in position for several days.

Rhinoplasty, or restoration of the nose.

The operation of restoring a nose which has been cut off, or lost by lupus or syphilis, is one which is little in favour with most surgeons of the present day, since it is found that the new nose being formed only of skin, generally either withers away or remains flat on the face, and in either case the patient's appearance is not improved. Besides, in the usual method of operation, the flap being taken from the forehead, another scar is added to the previous deformity.

The common plan, or the Indian operation, is to take a piece of paper, guttapercha, or leather, and adapt it to the stump of the nose so as to form as shapely a feature as may be; then lay this pattern on the forehead, and cut a flap of skin accordingly, leaving it attached by as broad a neck as possible to the bridge of the nose. In cutting this or any other flap, allowance must be made for the shrinking of the skin, so that the flap must always exceed the pattern a little in all directions. In order to form the columella a little tongue is left on the middle of what was the upper border of the flap, and which when it is twisted becomes the lower. The edges of the cleft should be refreshed before cutting the flap, and the latter brought down and attached as rapidly as possible in its new position by several points of silver suture. The new nose must be supported in position by a plug, or two plugs of suitable size and shape, and of some non-absorbing material, and supported on the plug by a pad and bandage loosely applied. When the union of the edges is complete and the transplanted flap perfectly warm and full, the neck may be divided, the rest of the cleft over the bridge of the nose pared, and the raw surface left by the division of the neck implanted there. The plug must be changed from time to time, but great care is required in doing this, and it should be put off as long as possible after the operation in order to leave the parts quiet till the edges have united firmly.

The same operation is also still sometimes done after the method of Tagliacotius by transplanting the flap from the patient's arm. An apparatus must first be manufactured which will keep the arm in comfortable apposition with the face; and then the flap is to be marked out and raised, much as in the Indian operation; but here the surgeon has the advantage that he can take a neck of any size that he wishes, so that possibly the flap is less liable to slough. The restrained position, however, is a great inconvenience, and necessitates the section of the neck as early as possible.[1]

Rhinoplasty is very liable to failure from sloughing of the flap, from want of union of the edge (especially when the tissues are cicatricial from old lupus), from erysipelas, and from secondary hæmorrhage. It is, therefore, not an operation which the surgeon should recommend.[2] Mr. Skey, who had much

[1] An interesting example of the successful performance of the Tagliacotian operation will be found recorded by Sir W. MacCormac, in the 'Clin. Soc. Trans.' vol. x. p. 181.

[2] Some novel attempts have recently been made to obviate the many causes of failure in rhinoplasty and other operations by transplantation. Thus Dr. Hardie, of Manchester, has transplanted the distal phalanx of one of the fingers into the nose in order to provide a bony base for the transplanted flaps ('Brit. Med. Journal,' Sept. 25, 1875), and Dr. Wolfe, of Glasgow, has even gone so far as to assert that no vascular connection with its original neighbourhood is necessary for the transplanted flap, but that the skin may be simply cut

experience in it, says: 'Let it be the patient who urges the operation.' And in the present day, when so many new materials are in use for masks, it will be found that a person who can command the necessary assistance will derive much more advantage from the services of the mechanician than the surgeon. I once met with a patient who managed to make for herself a far better nose, in some way which she would not explain, than any which rhinoplasty could have provided.

Operations for contracted cicatrix.

The contraction of scars, especially those of burns, frequently leads to terrible distortion, particularly in the neck and at the flexures of the joints, as the axilla and the fingers. As I have said above (p. 110) much of this could be avoided by careful extension during the healing process, and by promoting rapid union; but in many cases, especially in children, some amount of contraction is often inevitable.

It is very difficult to obtain permanently satisfactory results by operation in these cases. Consequently every attempt should be made to stretch the cicatrix by mechanical means before any plastic proceeding is undertaken. When, however, the latter becomes necessary, several different measures present themselves for selection. The simplest is merely to divide the cicatrix, put the parts forcibly on the stretch, and let the gap fill up by granulation, keeping the apparatus constantly applied till the scar is completed, which may be hastened by skin-grafting. I have seen this method succeed in deformity from scarring in the limbs, but in the neck I believe it always fails. The gap left by the division of the cicatrix may be filled at once by a flap cut from the thorax or from the back of the neck and made to glide on its base, so as to be attached to the edges of the divided scar, or rather to the line of division which is carried between the scar and the integument supposed to be healthy.[1] But the objection to this plan is that the edges of the cleft left by such divisions are always more or less cicatricial and the base of the cleft is also unnatural in structure, so that union cannot take place rapidly. Now, it is on the occurrence of rapid union that all prospect of success in plastic proceedings depends. A somewhat more satisfactory result may be hoped for if all the cicatrix can be extirpated, but this is usually impracticable in the neck. The result of such operations, as far as I have seen (and I have performed and seen many such), has been that even in those which seemed most successful at first, where almost the whole flap united kindly and the deformity was at first greatly lessened, some part remained long unhealed, and at this point a band of cicatrix ultimately formed which subsequently, in spite of the best efforts of the surgeon, contracted slowly and to a great extent reproduced the deformity.

Cheiloplasty.

Again, the deformity of the lip is a very difficult feature in contractions of the neck. The lower lip gets drawn down, presenting its mucous surface externally, and causing great distress from dribbling of saliva as well as distorting the other features. This is best dealt with by freeing the reversed lip from the jawbone as well as possible with the knife, refreshing its upper edge, and drawing over it two pieces taken from the cheek and corners of the mouth. These pieces are cut by a line sloping away on either side from the centre of the lower lip to the base of the jaw, and continued along that bone

from the arm or other part and inserted into the face, and will adhere and grow there (ibid. Sept. 18, 1875).

[1] Mr. Butcher has shown how much assistance may sometimes be afforded in these cases by subcutaneous division of the cicatrical bands around the chief scar.

as far as may be necessary, but so as not to wound the facial artery. These two pieces are movable enough to unite with each other in the middle line, while their bases are sewn into the refreshed edge of the lower lip. Similar operations may also be performed in cases where the upper or lower lip has been destroyed by cancer or injury.

Webbed fingers and toes.

A somewhat rare deformity is that in which the fingers are united by a fold of skin either in their whole extent or for some distance in front of the natural cleft. The same deformity is found in the toes, but it is of no consequence there. In the hand, however, it so materially limits the movements that it is of great importance to remedy it if possible: but it is very difficult. The difficulty consists in the great tendency to cicatrisation commencing at the posterior angle of the wound, in the situation of the natural cleft. If this does commence, it will surely though gradually extend forwards till the web is reproduced and tighter than before, because cicatricial. Of a great number of methods which have been employed in the treatment of webbed fingers, I will only mention two. One is to procure a permanent opening in the situation of the natural cleft by the insertion of a ring—much as the hole in a lady's ear is kept open—and when this opening is completely and permanently established to enlarge it by the insertion of tents or wedges increasing in size. A large separation being thus made at the cleft, the web in front can be divided gradually by elastic pressure; or else, after the hole has been established, the web in front is divided close to one of the fingers, and the two flaps thus obtained are united together to cover the other finger, for which they are amply sufficient. Then a covering is obtained for the denuded finger out of some distant part of the body—say the outer side of the thigh. A flap is dissected up and left attached by both its ends, and the finger is thrust in below it—much as the hand is thrust into the pocket—and the edges of the flap united to those of the cleft. When union has taken place, the ends are divided, the hand released, and the cut ends implanted.

AMPUTATIONS.

General observations.

THE chief indications in amputation are—1. To remove the whole of the parts which are diseased or injured beyond the prospect of recovery. 2. To avoid all unnecessary loss of blood. 3. To cut flaps of proper shape and long enough to cover the bones without any tension. It might, perhaps, be added that the main nerves ought never to be left so long as to be exposed to pressure by the ends of the bones.

The chief methods of amputation are as follows:—

Circular amputation.

The *circular*, in which a cut is made all round the limb through the skin and fat, which are thrown back from the muscles something like the cuff of a sleeve,[1] then the muscles are divided by one or more circular sweeps down to the bone, then all the soft parts are retracted from the bone or bones, and the latter are sawn about an inch above the part first exposed by the division of the muscles.

Retractors.

In all kinds of amputation retractors are sometimes wanted, but more generally in the circular. They should never be required if the parts are healthy, but may be indispensable when they are stiff from œdema or inflammation. For the thigh or arm they are usually made of two plates of metal, each having a handle at each end and a semicircular notch in the upper edge.

[1] This dissection is omitted by some operators, who merely divide all the parts down to the bone by successive circular cuts, while an assistant retracts the parts as they are divided.

One of these is placed above the bone, the other below. The two notches form a hole through which the bone passes, and the soft parts are then pulled forcibly upwards, the saw being applied just below the retractors. A split piece of stout cloth will answer the same purpose. When there are two bones a tongue must be torn in the cloth and passed between the bones, the ends are then crossed and the cloth drawn upwards.

Flap amputations are now more in use than circular. The flaps are cut in two ways, by transfixion or incision. In the former plan when the flaps are made as is usual in front and behind the limb (antero-posterior flaps), the knife is passed as near as possible in front of the bone, or bones, just below the place where the saw is to be applied. Then the knife is carried downwards and outwards, cutting as long an anterior flap as necessary; the same thing is done behind, the flaps are drawn up, the bones cleaned a little higher up, and the saw applied. The same operation is sometimes done on either side of the bone (lateral flaps), chiefly in the upper arm. In this way the flaps must be formed of all the tissues of the limb; but if the operator wishes to take skin only, or in varying proportion to the muscles, he must make his flaps by incision, carrying the knife along any lines which he may find suitable, and then raising the parts from without inwards, and taking care to take an ample allowance of fat and other subcutaneous tissues along with the skin. The flaps formed by transfixion must be oval, those formed by incision may be of any shape. They may also be formed entirely of skin, the muscles being divided straight down to the bone; or, they may include all the tissues of the limb (as in Teale's amputation), or, as is now very commonly done, the flaps of skin having been thrown back, the muscles may be divided as in the circular amputation—an operation usually spoken of as 'the modified flap amputation.' I shall endeavour as well as my space allows to illustrate each of these methods of operating in speaking of the amputations of different members, in doing which I shall describe the method which seems best adapted to each, though in all of them it is quite feasible, nay is necessary sometimes, to adopt a method the farthest possible from the one here recommended. For instance, in amputating at the hip or shoulder the flap amputation by transfixion is the best; but it is often necessary to cut the flaps by incision, and even the circular amputation may be performed.

Flap amputation.

The instruments required for amputation are very simple. In the present day many amputations are performed with a simple scalpel rather larger than a dissecting knife, but generally an amputating knife is employed. This should have a sharp point and a fine narrow blade,[1] and its length should be proportioned to the size of the limb. The shorter it is the easier it is to manage, but for transfixion-operations its length must considerably exceed the thickness of the limb. For cleaning the bones when there are two, a small double-edged catlin is convenient. The back of this is pressed against the farther bone, dividing all the soft tissues and periosteum, then the point is thrust between the bones until their periosteum is also completely divided where their surfaces are opposed, then the point is disengaged by pressing the front of the blade on the nearer bone, and so its edge is drawn up the nearer bone till it comes to the point from which it started. A peculiar manipulation (called the figure of 8) is sometimes taught for doing this, but it requires really no special instruction. The amputating saw, a stout strong-backed saw, should be in readiness, and a pair of sharp bone-forceps to cut off any splinter that may be left projecting, and if the amputation is performed in a case of

Instruments for amputation.

[1] The old 'circular' knife with a round point is now very rarely used.

fracture, the lion-forceps are required to hold the end of the fractured bone while it is sawn smooth above. A common scalpel, tenacula, ligatures, and the contents of the pocket case complete the armamentarium.

Dressing the stump.

After amputation the wound is to be dressed as prescribed in Chapter I., a piece of drainage-tube being passed through the deep part of the stump, in order to drain off the abundant sero-sanguineous discharge which usually collects in the cavity if it is tightly sewn up, and gives rise to suppuration. If the stump is long enough the patient will derive much comfort from its being placed on a splint and lightly bandaged, and the splint may be slung if required. When the flaps are necessarily left somewhat deficient in length, or when they retract afterwards so as to threaten to leave a conical stump, much benefit may be obtained by careful bandaging, the parts being kept well drawn forward while the bandage is being applied; and still more advantage is derived from the application of continuous traction by means of a weight acting on a stirrup of strapping, which has been secured to the stump by one or two circular strips, a few inches above the incision.

Amputation at the shoulder-joint.

Amputation at the shoulder-joint is best performed by transfixing, and cutting the flaps from within outwards. The situation of the joint having

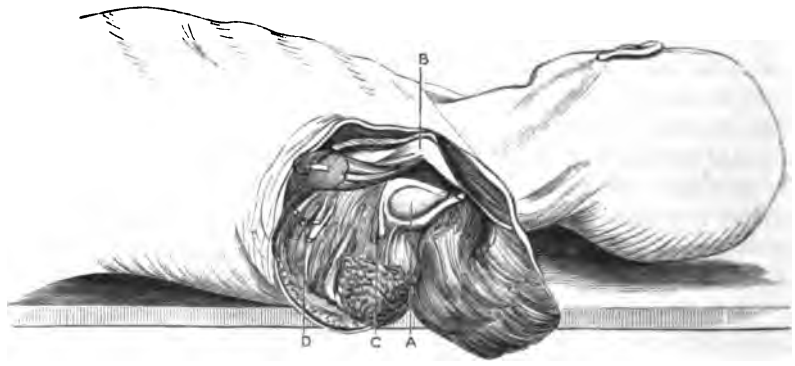


FIG. 403. The stump of an amputation at the shoulder-joint. A, The glenoid cavity, the long tendon of the biceps, seen at its upper part; B, The coracoid process with the coraco-brachialis muscle and short head of the biceps; C, The posterior circumflex artery and circumflex nerve; D, The axillary vessels and brachial plexus. Above the letter A is seen the mass of the deltoid: above the letter C the triceps muscle. In the depression between the deltoid and glenoid cavity are the tendons passing to the great tuberosity. That of the subscapularis is in the depression between the glenoid cavity and coracoid process. Above the coracoid process is seen the pectoralis major.

been already fixed in the surgeon's mind, he gets an assistant to compress the subclavian artery, while a second manages the arm for him, holding it at first at right angles to the patient's body. The operator, standing behind the patient, enters the knife just behind the posterior flap of the axilla, and brings its point out close to the coracoid process. It is quite easy to open the joint with the point of the knife as it passes across. Then a large flap is cut out of the deltoid muscle, which is retracted by the second assistant, who now brings the arm down to the side and pushes the head of the bone up out of the joint as the operator passes the heel of the knife round it. The knife having now quite severed the articulation, the second assistant again holds the arm perpendicular to the body, while the surgeon brings his knife parallel with the humerus, and cuts a short flap out of the parts internal to it in the axilla. One of the assistants or the operator himself follows the knife with the fingers inside the flap to catch the axillary artery between the fingers and

thumb in case the pressure on the subclavian is insufficient. On an emergency (such as sometimes occurs in war) the pressure on the subclavian may be dispensed with, and the operation can be and has been done without the aid of any trained assistant at all, the operator being aided only by a man who manages the arm for him and helps him to tie the vessels. If it is found more convenient, the surgeon in operating on the right arm may stand in front of the patient, and cut the anterior flap by entering the point of the knife by the side of the coracoid process, and bringing it out near the posterior flap of the axilla.

There are many other ways in which this amputation can be performed by cutting flaps from the skin inwards, by a modified circular method, or by using any tissue left uninjured to cover the glenoid cavity. I have seen cases in which the tissues were so far torn off the arm and scapula that even this was impossible, yet which healed well by granulation, and left really little to desire. Amputation at the shoulder-joint is by far the most successful of all the major operations; but it should not be performed except in cases of evident necessity, since any movable stump which can be formed out of the arm, however short, will be of some use to the patient.



FIG. 404. Diagram of a section of the upper arm, showing the parts as they would be seen in a circular amputation.
A, The brachial vessels, having the median nerve in front of the artery, and the ulnar at some distance below it, along with which the inferior profunda artery runs; B, The basilic vein with the internal cutaneous nerve; C, The humerus, lying close to which are seen the musculo-spiral nerve in the substance of the triceps muscle and the superior profunda vessels along with it. In front of the humerus is seen the musculo-cutaneous nerve lying between the biceps and brachialis anticus, and in the superficial cellular tissue the cephalic vein. Muscular vessels will probably require the ligature, lying in the substance of the three muscles.

Amputation of the arm.

Amputation through the continuity of the humerus can be performed in any way that the operator fancies, or that the nature of the disease or injury points out as advisable. One of the best methods, I think, is the combination of skin-flaps with a circular incision of the muscles. The tourniquet may be put on near the axilla, or Esmarch's bandage may be applied, or the axillary artery may be held by an assistant. The operation is now comparatively rarely performed, chiefly in cases of complicated injury in which it is impossible to preserve the limb, or cases of malignant disease. In the former case very few vessels will require ligature, probably the brachial and superior profunda will be the only ones (Fig. 404). In cases of rapidly-growing tumour, of course, the smaller arteries will have become enlarged, and must be tied.

Through the elbow.

In some rare cases amputation has been performed through the elbow-joint. There would be no difficulty in fashioning the flaps, but the opportunity for performing the operation must be very rare, for any part of the forearm which can be preserved would be useful, and if the whole forearm is destroyed the humerus is also probably injured, and its end must be removed. In the only case in which I have as yet performed this amputation I made a long skin-flap from the back of the limb, and turned it over to meet the parts in front which were divided by a transverse cut. The resulting stump was an excellent one; and I have seen excellent stumps of this amputation from the practice of other surgeons.

Amputation of the forearm.

Amputation of the forearm is a very common operation, and is performed on account of laceration of the hand, or of caries of the wrist, or malignant tumour.

The rectangular or Teale's amputation in this part of the limb is a very good method, for the chief difficulty in amputation of the forearm is caused by the numerous tendons (especially near the wrist) which are liable to be cut irregularly, and so interfere with a perfect result. In the rectangular operation these are divided straight across and the flaps formed are more regular. I usually make the long flap in the rectangular amputation of the forearm in front—preferring this to Mr. Teale's original method, in which the long flap was made behind—a method still followed at Leeds. The long anterior flap gives, I think, a better covering for the bones, and a more equable thickness of parts in the flap. Either method, however, may be adopted. But many other plans are in use; a modified flap—i.e. skin-flaps with circular incision of the muscles—or, on the other hand, a circular sleeve of skin turned back, and then short flaps cut out of the muscles by passing the catlin in front of the bones, below the two main arteries, and cutting outwards, and then making a similar small flap behind (as recommended by Sir P. Hewett), or the common circular operation, will all give good results when carefully executed. If any tendons project irregularly they must be trimmed off before the flaps are adjusted. The position of the vessels can be seen from the annexed diagram (Fig. 405).

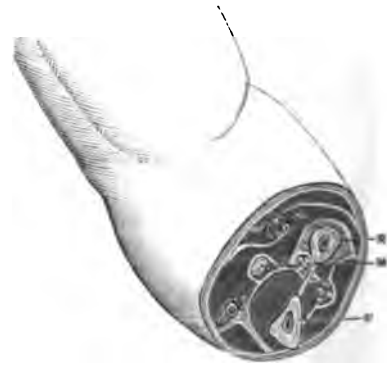


FIG. 405. Section of the forearm about the middle. R, Radius with the radial vessels and nerve in front of it; M, Median nerve which is sometimes accompanied by a vessel requiring the ligature; U, Ulna overlapped by the fl. prof. digitorum and having the ulnar vessels and nerve in front of it. The interosseous membrane is seen between the bones, and, lying on it, the anterior interosseous vessels. The posterior interosseous vessels are seen between the deep and superficial layers of muscles at the back.

Amputation at the wrist.

In some rare cases the whole hand is removed at the wrist. This is best done, I think, by cutting two tolerably equal semicircular flaps back and front from the skin inwards. If the pisiform or unciform process is inconveniently prominent it may be cut off.

Amputation of the fingers.

The fingers are constantly amputated at any of their three joints, sometimes through the continuity of one of the phalanges, and more frequently through the metacarpal bone, the head of which is removed along with the finger. The two terminal phalanges are best amputated by cutting pretty straight into the articulation on its dorsal aspect, corresponding to the central fold of the skin on this side of the joint, and then passing the knife through the joint and shaping a long flap out of the tissues on the palmar surface. In amputating the knuckle it is important in a labouring man to preserve the head of the metacarpal bone. Those who study appearances sometimes recommend its removal in persons who are not called upon for manual labour; but this weakens the hand so by the section of the transverse ligament and other structures, that it seems to me better always to preserve the head of the bone if possible, though the gap between the two fingers is no doubt an ugly deformity. In the dissecting-room the amputation may be accomplished with a single sweep of the knife. The knife should be long and thin, but stout. The finger to be removed (say the middle) is seized and drawn to the

ulnar side, the heel of the knife is laid on its radial side, at the anterior end of the incision, and carried on with a sawing motion backwards till it arrives at the position of the joint. It is now turned transversely through the joint, and then forwards to cut out the flap on the ulnar side. The various exigencies of injury and disease often render this operation impracticable on the living subject, and the flaps must be shaped as the operator best can, but inclining to this model. If the head of the metacarpal bone is to be removed, the incision must be prolonged sufficiently backwards to allow of the bone being cleaned and the cutting forceps applied.

Amputation of the thumb.

The thumb is very rarely amputated, since its preservation, or that of any part of it, is so useful as a *point d'appui* to the fingers, even if it is itself immovable, that surgeons generally leave cases of injury of the thumb to nature; and in cases of diseased joints or phalanges the expectant treatment is still more plainly imperative. The thumb may be amputated at its joint with the trapezium bone by carrying an incision forward on the dorsal aspect of the metacarpal bone from the position of the joint, then making it include the metacarpo-phalangeal joint in an oval manner, and so returning to the point from which it started. Thus an ample covering is secured for the flap, and no incision made in the palm. The thumb being freely divided from the fold uniting it to the forefinger, is lifted up, the knife passed below its metacarpal bone, separating it from the palmar muscles, and then by dividing the ligaments which unite it to the trapezium the whole member is removed; or palmar and dorsal flaps may be formed by passing a long bistoury in front of the thumb from near the situation of the joint to the fold between the thumb and forefinger, and then cutting out a large flap from the mass of muscles of the thumb. The joint, which is now exposed, is divided, and a smaller flap made from the dorsum. The radial artery is sometimes divided in the operation, though by carefully keeping the knife close to the bone as the operator passes through the joint this may be avoided.

Amputation at the hip-joint.

The operation at the hip-joint is the most formidable of all the amputations. In performing it it is often essential to get the operation over as rapidly as possible, and this is the case especially when a tourniquet cannot be applied. The surgeon will require at least four assistants: one to administer the anæsthetic; a second to attend to the tourniquet, and if needful, compress the artery in the groin; a third to support the limb, and a fourth to manipulate it so as to facilitate the movements of the knife. The tourniquet which is in use in this amputation is one invented by Professor Lister, and generally called after his name; but he has pointed out that Professor Pancoast, of Philadelphia, had previously designed a similar instrument.[1] It is a large horse-shoe tourniquet, resting by a broad base on the loins and somewhat steadied by a strap which passes from its expanded end to its arm. The end of the arm carries a screw and pad. The pad is applied over the aorta, just above the umbilicus, and by screwing it home (if the tourniquet is of the proper size) the pulse in both groins can be arrested, which shows that the aorta is commanded. This method of controlling the hæmorrhage is most efficient, and I have used it several times with perfect success. In a child who is not too stout the aorta can be easily commanded by manual pressure. But the pressure required to stop the pulse in the abdominal aorta in an adult, especially if the abdomen is stout, must be great, and sometimes produces alarming dyspnœa. Accordingly Sir J. Lister himself no longer recommends it. Many other plans are in use. Mr. Davy

The aortic tourniquet.

[1] 'Syst. of Surg.' 2nd ed. vol. v. p. 652.

Amputation of the thigh.

The thigh may be amputated in various ways, and at any level, the femur being divided as high as the trochanter, or as low as the condyle; but surgeons are always anxious to go as low as is consistent with removing the disease, remembering Dieffenbach's saying that 'the danger rises with every inch.' The old circular amputation, or a combination in which the skin is cut in flaps, the longer anteriorly, and then a circular sweep is made through the muscles, seem to me the best methods. For the amputation close on the knee-joint Mr. Carden's method is now in great favour. Its principle is that of making the whole stump out of one long anterior flap of skin reaching below the patella, and cutting the posterior skin and muscles straight down to the bone; then raising all the soft parts somewhat from the bone and dividing it horizontally through the condyles, below the medullary canal. This is sufficient in most cases of disease of the knee, and leaves a very long and very useful stump. It is believed also to be less exposed to the danger of osteomyelitis than the operations are in which the medullary canal is laid open. Flap operations can also be performed in any part of the thigh, either by anteroposterior or lateral flaps. Mr. Teale's method by rectangular flaps is not applicable to the thigh, in consequence of the high level at which the bone must, on this method, be necessarily divided.

Amputation through the knee-joint.

Amputation through the knee-joint, leaving the whole cartilaginous surface of the femur and patella intact, is an operation of which I am myself rather fond, in cases where the whole of the leg is destroyed by accident, or where malignant disease attacks the tibia, yet there is plenty of sound skin below the knee.[1] A long skin-flap is cut out of the front of the leg by an incision, convex downwards, starting from the back of either condyle and reaching four or five inches down the leg. The skin and the patella having been raised from the bones and the lateral ligaments completely divided, the surgeon changes the scalpel for the amputating knife, which he passes behind the tibia and cuts a posterior flap outwards.[2] This flap need only extend a very short distance if the anterior flap is long enough, and it is better so, as the wound then falls completely behind the femur. The popliteal and one or two articular branches are probably all that will require ligature.

This operation is variously modified. Mr. Butcher describes an operation as 'amputation at the knee-joint,' in which the end of the femur is cut through and the stump made chiefly from the skin and muscles of the calf, the latter being hollowed out as far as is necessary to render the flap pliable and admit of its being attached to the skin in front of the femur. This is, as it were, Carden's method reversed, and the latter is generally preferred.

Again there is an operation which goes usually by the name of 'Gritti's amputation,' in which the flaps are formed as for the amputation through the knee-joint, but, either in consequence of disease or injury in the lower end of the femur, or from not being able to get sufficient sound tissue to cover the condyles, the operator is obliged to saw through them. Then the patella is sawn perpendicularly, so that all its cartilage is removed. The anterior flap is brought over the sawn end of the femur, and the sawn surface of the patella applied to that of the femur.

[1] The main advantages of amputation at the knee are the length and power of the stump and the broad unirritable face for application of the artificial leg. Its disadvantages are the tendency to sloughing of the long flap and to abscess extending up the thigh.

[2] Or the posterior flap may be cut from the skin inwards with the same knife as was used in cutting the anterior flap, or the whole operation performed with a short amputating-knife.

Or, in the amputation through the knee-joint, the chief flap can be made from behind, and the scar brought up in front of the femur, the patella being removed; or the amputation may be performed by lateral skin-flaps—a method which is recommended as not requiring such long flaps, so that sloughing is less probable, and as bringing the cicatrix to lie in the hollow between the femoral condyles.[1]

Amputation of the leg.

Amputation of the leg may be performed by the circular method, which secures a somewhat lower section of the bones than any of the flap operations, or by skin-flaps and circular section of the muscles; or by flaps formed on the anterior aspect by section from the skin inwards, and on the posterior by transfixing the parts and cutting outwards. In transfixing from the tibial side the operator must be careful not to pass his knife through the interosseous space in front of the fibula, instead of behind it. I have seen this twice done on the living subject.

Teale's amputation.

Mr. Teale's operation, by rectangular flaps, is, however, a very good method in this amputation, when the operator has no objection to dividing the bones somewhat higher up; and this seems a convenient place for describing it. No amputating-knife is required for this operation, which is performed with a rather large scalpel. Having made up his mind where he will divide the bones, the surgeon measures (with a tape or with his eye) the circumference of the limb, he takes a horizontal line the length of half this circumference with its extremities lying behind the tibia and fibula, and from the ends of this line he draws two incisions of the same length as the base vertically downwards,[2] and unites their ends by an incision parallel to the base. He cuts through all the tendons and vessels straight down to the bones and interosseous membrane, and then raises all the parts, including the anterior tibial vessels, from the bones and interosseous membrane. Much care must be taken not to notch the artery in doing this, the edge of the knife being kept always on the membrane. Having raised the anterior flap completely, the operator cuts the posterior flap by a transverse incision running across the back of the leg down to the bones, the posterior flap being a quarter the length of the anterior. The interosseous membrane being divided and the bones perfectly cleaned, the saw is applied. For this purpose the leg is turned outwards, so that the

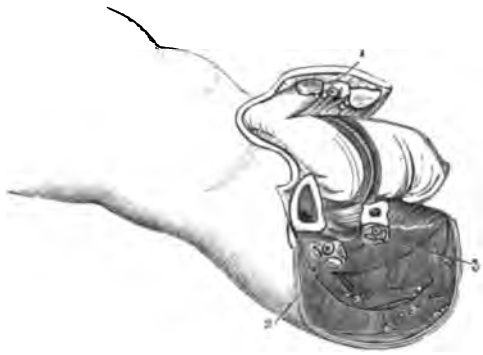


FIG. 408. Diagram of Teale's amputation of the leg, performed a little below the centre of the limb. The anterior long flap has been bent on itself, the better to show the position of the vessels. 1. The anterior tibial vessels and nerve. The artery is shown exposed throughout the whole length of the flap, where it has been peeled off the interosseous membrane. The tibialis anticus muscle is seen on its tibial side, the extensor proprius pollicis and extensor longus digitorum on its fibular side, external to which is the mass formed by the peroneal muscles, here perhaps rather exaggerated in size. 2. The posterior tibial vessels and nerve lying near to the interosseous membrane, but separated from it by the tibialis posticus muscle, and from the tibia by the flexor longus digitorum. 3. The peroneal vessels lying close to the fibula, in the substance of the flexor longus pollicis. In the cut face of the short, and thick, posterior flap are seen the section of the soleus, and superficial to this that of the gastrocnemius muscle, each containing the mouths of several muscular vessels.

[1] On the subject of amputation at and near the knee, I would refer the reader to papers by Mr. Pollock and Mr. Stokes in 'Med.-Chir. Trans.' vol. liii.

[2] As the limb rapidly decreases in size the lower end of the flap includes much more than half the circumference of the leg.

fibula is first presented to the operator, and the division of the fibula completed while the tibia is still only half sawn through. The vessels having been tied (see Fig. 408), the long anterior flap is bent over, its lower edge sewn to that of the posterior flap, and its doubled lateral edges stitched together. If the flaps have been cut truly, the whole fits perfectly, and when it unites kindly it makes a most excellent stump; but it is not a suitable operation for weakly persons, on account of the probability of sloughing of part of the long flap, and if secondary hæmorrhage comes on it is very troublesome.

Mr. H. Lee has proposed to reverse Teale's proceeding, making the long flap from behind instead of in front, so as to obtain thicker tissue for the long flap, which is therefore less liable to slough, and to avoid leaving a long piece of nerve (the anterior tibial), which has to be bent on itself in adjusting the flaps.[1] I have seen very good results from this operation in Mr. Lee's hands and my own ; but it is somewhat difficult to be certain of the position of the posterior tibial vessels in performing it, and the tendinous part of the gastrocnemius muscle in the lower part of the leg does not easily lend itself to the bending which the long flap has to undergo.

Teale's method provides the bones with a thick cushion formed in great part of muscles. These muscles ultimately waste away, but while they are undergoing this process the stump becomes consolidated, and the skin does not adhere to the bones, so that the face of the stump will bear the wooden leg to press directly on it.

In performing amputation of the leg when the tissues are at all consolidated by inflammation, it is often difficult to retract the parts from the bones. In such cases a linen retractor is required. This is made with a long piece of stout linen, in one end of which a tongue is cut or torn, leaving this end to consist of three strips, the central one the narrowest. This tongue is passed through the interosseous space, the broader ends are crossed in front of the bones, and thus the parts can be forcibly pushed up and the bones exposed much higher than is otherwise possible.

In amputating the leg the posterior tibial artery often retracts into the corner of the stump (especially when the flaps are made by transfixion), and it is very troublesome to tie it, or any of its branches divided near the trunk.

Syme's amputation.

Syme's amputation through the ankle-joint is thus performed, if we follow the directions of its author:—The anterior flap is formed by drawing the knife from the point of the external malleolus to the corresponding point on the opposite aspect of the foot, i.e. below and behind the internal malleolus. The anterior flap can be made to extend down the dorsum of the foot a short distance if the surgeon thinks fit. The posterior flap is made by drawing the knife from one end of the anterior flap to the other across the lower surface of the os calcis, inclining it rather towards the heel, so that the incision slopes backwards. The posterior flap is then dissected back and thrown round the end of the os calcis until the tendo Achillis is separated from that bone and the knife turns round the upper aspect of the calcaneum. In doing this the operator must be careful to keep the edge of the knife directed towards the bone, so as not to score the skin and not to make a button-hole. It is impossible to do this satisfactorily if (as is often directed) the flaps extend from one malleolus to the other; for this makes the inner part of the flap so high and broad that it can hardly be dissected round the heel without great force. When the os calcis is denuded, the anterior flap is to be thrown

[1] 'Med.-Chir. Trans.' vol. xlviii. p. 195.

up, the ankle-joint opened, the knife passed round the inner and then the outer malleolus, and the foot removed. Next the tibia and fibula are to be cleaned for about half an inch, taking care by keeping the knife close to the bone that the posterior tibial artery is not punctured, and a thin horizontal slice of the tibia with both malleoli sawn off. The arteries are then secured (Fig. 409), and the flaps sewn up. Many surgeons think it best to pass a drainage-tube from one angle of the wound through an opening made at the back near the tendo Achillis, so as to avoid the bagging of matter in the posterior flap. Otherwise it is almost always necessary when suppuration sets in to make an opening in the flap.[1]

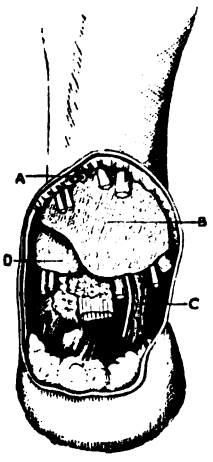


FIG. 409. The stump of Syme's amputation. A, The anterior tibial vessels and nerve, divided below the point where the extensor proprius pollicis passes over them. B, The section of the tibia. D, That of the fibula. C, The posterior tibial artery and its bifurcation. External to this is seen the tendon of the flexor proprius pollicis, and in the middle line the tendo Achillis.

The operation, however, is much more easily performed in the reverse manner to that prescribed by Mr. Syme. The flaps are marked out, the anterior one formed, the joint opened, and then the posterior flap dissected from the upper part. In this way the difficulty of dissecting the posterior flap round the heel is quite avoided, and it is a matter of indifference to what exact points the incisions are drawn.

This amputation is now sometimes performed in the sub-periosteal manner, the periosteum of the os calcis being raised in the lower flap, and only the malleoli being removed from the bones of the leg. The object is to give a longer and more solid stump.[2]

The great recommendation of Syme's amputation is the excellence of the stump which it forms, the tissues of the heel being capable of sustaining any pressure, so that the patient walks about easily with a kind of elephant's foot apparatus, which can be made to resemble the natural foot to a great extent by having a foot-piece put on to it, and he can walk a short distance well enough without any apparatus at all. The operation is available in most cases of disease of the ankle and tarsus, and in many cases of injury.

Pirogoff's amputation.

Pirogoff's amputation is a modification of Syme's, in which the extremity of the os calcis is saved and is applied to the cut end of the tibia, in order that it may unite with that bone and form a longer stump. The flaps being marked out in the same way as in Syme's amputation the saw is applied to the incision across the under surface of the os calcis and that bone is sawn in a direction sloping upwards and backwards to its upper surface behind the ankle. Then the joint is opened and the malleoli and under surface of the tibia removed just as in Syme's amputation. The section of the os calcis is then placed in apposition with that of the tibia, and the wound united. When all goes well Pirogoff's amputation forms a very good stump; but it is not very often available, for in cases of disease requiring amputation the os calcis is usually, or very often, involved, and in cases of injury either, on the one

[1] The reason why Mr. Syme was so emphatic in directing the operator to avoid making a 'button-hole' was not so much because the hole is in itself a disadvantage, as because it shows that the knife is directed towards the skin and is dividing its nutrient vessels.

[2] G. H. B. Macleod and Joseph Bell in 'Brit. Med. Journ.' vol. ii. 1875.

hand, more of the foot can be preserved, or, on the other, the surgeon finds himself obliged to amputate through the leg.

Subastragaloid amputation.

In some cases it may be that the os calcis and the bones of the front of the tarsus are diseased or injured, but the astragalus is healthy; and then a very good stump may be made by forming a heel and a dorsal flap long enough to meet beneath the astragalus, severing that bone from its connection to the calcaneum and scaphoid, and leaving it in the ankle, while the rest of the foot is removed, but I have not had any opportunity of seeing this operation practised. It does not seem of much importance by what precise incisions the flaps are formed, so that they are sufficiently ample, and that the lower flap is formed chiefly of the tissues of the heel, as in Syme's amputation. I must refer the reader for the details of the published cases of this rare operation to Mr. Hancock's 'Lectures on the Anatomy and Surgery of the Foot,' pp. 191 et seq., where he will find described also a modification of the subastragaloid amputation devised and performed by Mr. Hancock himself, and bearing the same relation to the ordinary subastragaloid amputation as Pirogoff's does to Syme's amputation. Mr. Hancock preserves a portion of the back of the os calcis in the heel-flap, saws off the head of the astragalus and its lower articulating surfaces, and then adapts the cut surface of the os calcis to that of the astragalus. The result, as figured in Mr. Hancock's work, is an excellent stump, almost as long as the sound limb, and quite capable of bearing any amount of pressure. The distinguishing recommendation of the subastragaloid amputation is the increased length of the stump, even as compared with Pirogoff's, and still more with Syme's amputation, and this advantage attaches still more strongly to Hancock's amputation.

Hancock's amputation.



FIG. 410. Skeleton of the foot. Chopart's amputation is performed at the transverse tarsal joint, where the bones are separated from each other behind. Lisfranc's at the tarso-metatarsal articulations, where they are separated in front.

Chopart's amputation.

Chopart's amputation is performed through the transverse tarsal joint (Fig. 410). The tuberosity of the scaphoid is easily felt, and the position of the calcaneo-cuboid joint half-way between the external malleolus and the point of the fifth metatarsal bone is known. An incision is drawn across from one of these points to the other with a scalpel, and a short dorsal flap is cut, the transverse tarsal joint opened, and the bones fairly separated from one another. Then by means of an amputating knife a long plantar flap is cut outwards, or towards the skin. This flap can, of course, be cut with the scalpel by incision from the skin almost equally readily.

One objection often made to Chopart's amputation is that the tendo Achillis is liable to displace the bones upwards, being no longer antagonised by the tendons in front, so that the scar is brought downwards and the stump becomes too irritable to bear the pressure. This defect is not always noticed, nor is it easy to see exactly on what its occasional absence depends. It may be avoided, according to some, by subcutaneous section of the tendo Achillis at the time of the operation, a complication which, however, it is desirable

to avoid. The plan of passing the sutures through the tibial tendons, so as to attach them to the cicatrix (due, I believe, to the late Mr. Delagarde of Exeter) is worth bearing in mind.

Lisfranc's or Hey's amputation.

Lisfranc's operation consists in removing the whole metatarsus, with the toes, and leaving the tarsus intact. Hey's amputation is the same, except that the second metatarsal bone is divided, and its head left in the articulation between the cuneiform bones; or the projection of the internal cuneiform bone is sawn through and removed along with the toes, after the other tarso-metatarsal joints have been divided with the knife. The projection of the second metatarsal bone backwards (Fig. 410) is the only difficulty in this operation. The position of the articulation of the great toe with the internal cuneiform, and of the little toe with the cuboid being fixed, a curved incision is drawn from the one point to the other and as much flap as possible taken from the dorsum. The flap being thrown back, the joint between the great toe and cuneiform bone is divided, then the point of the knife is carried directly backwards till it is stopped by the middle cuneiform bone, when it is directed outwards, and then forwards again, so as to cut entirely round the head of the second metatarsal. Then by pulling the metatarsus forcibly downwards, while the knife is passed along the line of the articulations, which slopes backward, the disarticulation is completed, and the plantar flap may be cut by transfixion or incision, as in Chopart's amputation. This operation is used almost exclusively in cases of injury, so that as much flap as possible must be taken on both sides to compensate for any possible sloughing.

Finally, amputation may be performed through the tarsus in any situation, by simply fashioning flaps and sawing through the bones; and this proceeding is, in the opinion of Mr. Hancock, the highest authority on these operations, superior to the amputations performed through the articulations.

The toes may be amputated exactly as the fingers are, but here it is still more undesirable than in the hand to remove the heads of any of the central metatarsal bones. If any of the smaller toes require removal the whole toe should be amputated, since the portion left would be useless, and might be in the way. The heads of the first and fifth metatarsal bones should always be cut off in amputating those toes, the incision through the bones being sloped off if possible. The great toe with the head of its metatarsal bone can be removed by a V-shaped incision; the point of the V lying over the middle of the metatarsal bone, in front and behind, and its limbs extending forward on either side of the ball of the toe, as far as is necessary to form ample lateral flaps. If the whole metatarsal bone is to be removed, the point of the V must be extended backwards as far as the situation of the tarsometatarsal articulation, and the toe having been removed the metatarsal bone is dissected out from the incision, care being taken, in dividing its head from the cuneiform bone, to keep the knife so close to the bone as not to wound the plantar arch.

EXCISIONS.

Excisions of joints and bones are operations which are quite of modern date, and which, in fact, could hardly be practised freely before the invention of anæsthesia. They are performed chiefly on account of disease of the articular surfaces or of the tissue of the bone excised, sometimes (as in excision of the scapula and clavicle) on account of the growth of tumours from the bone, sometimes as primary or secondary operations after injury.

General indications for excision.

It is very difficult to compress into a short compass any rules for the performance of excision which shall be of practical utility and of general application. Perhaps the most practical view of the matter is to consider the operation of excision as opposed (1) to the preservation of the limb without any operation, or at least without anything more than the laying open of sinuses and removal of dead bone, and (2) to amputation.

Excision as contrasted with the conservation of the limb.

1. Both in injury and disease the surgeon is much more disposed to adopt the conservative plan in the case of the hip and knee, and the operation of excision in that of the elbow; since the latter operation if completely successful gives a more serviceable limb than the natural cure. With this reservation it may generally be said that so long as the pain and exhaustion accompanying disease of the joint is not producing an obvious effect on the general health it is right to persevere in the attempt to save the limb without operation, and that in cases of injury much may be done in young subjects to preserve the limb, particularly after gunshot wound, by laying the joint fully open and removing splinters, the case being treated antiseptically: while excisions are extremely unsuccessful in such cases. Primary injuries of other kinds are rare, except in the elbow (where excision is usually advisable), but when they occur they are to be treated on the same principles. Finally, there are cases arising both from disease and injury in which there can be no doubt that the patient will recover with ankylosis of the limb; but the position or relations of the surfaces are such as to render it doubtful whether this will be a benefit to him. Cases of disease of the knee are not rarely seen in which the patient has rejected operation and has recovered, but with the bones so displaced and so insecurely ankylosed as to prove a source of lifelong trouble to him. A timely excision will often insure a useful limb.

Excision as contrasted with amputation.

2. In the knee and ankle excision should hardly be proposed after about forty years of age, and only rarely after thirty.[1] In the elbow and shoulder the same limits do not so strictly apply, yet in all joints it is more satisfactory when the patient has passed middle life to have removed the disease once for all. In no case should any joint of the lower extremity nor the wrist be excised unless the surgeon has the clearest evidence that the disease is limited to the immediate neighbourhood of the joint. Much more liberty may be taken in the shoulder and elbow. I have excised the elbow with great ultimate success in a case where nearly the whole shaft of the radius was diseased, and it is well known what extensive excisions of the upper end of the humerus are sometimes successfully practised in cases of disease following gunshot injury. Excisions of the lower limb are hardly ever successful in acute stages of disease,[2] while in the elbow, at any rate, the operation, in such circumstances, is often productive of great and immediate relief. Tumours of joints are, as a rule, to which few exceptions will be found, only appropriate for amputation. General constitutional disease is, like old age, a strong argument for amputation, when any operation is indicated.

In fine, excision is a more dangerous operation than amputation and is liable to many sources of failure, and practice to be successful must be based on a recognition of this truth.

[1] I have recently excised the knee in two cases at a time of life considerably beyond forty years of age, and in one of them with great success; but this can I think only be done successfully when the disease is in a very chronic condition, as in Mr. Gant's patient, æt. 53.—'Med.-Chir. Trans.' lvi. 213.

[2] Perhaps the ankle is an exception. I have excised this joint with success though acutely inflamed.

General directions for excisions.

The operations resemble to a certain extent the dissections by which tumours are removed. The diseased joint or bone may be regarded as a tumour to be exposed by appropriate incisions, the soft parts turned aside without injuring the main vessels and nerves, all its connections severed, and the whole of the morbid tissue removed. But there is this further consideration in performing an operation of this kind, that the morbid structure removed is an important part of the skeleton, and that the operation must be so performed as to make provision for the subsequent stability or mobility of the limb as may be required. Thus, in the excision of the knee, it is important that the bones should be firmly ankylosed, a result which is especially to be deprecated in the elbow. The instruments required in excisions are, in addition to the usual dissecting instruments, saws of various sizes, from the amputating to the 'key-hole' saw, retractors, the lion-forceps, and the cutting bone-forceps. In subperiosteal excisions the operator must have various raspatories, i.e. semi-blunt chisels or rasps, as well as the chain-saw, and a combination of a raspatory and director for the purpose of detaching the periosteum from the bone and carrying the chain around it. For some excisions a combination of a staff and director is very useful—the 'excision director.' This is shaped like a lithotomy staff, and mounted on a jointed handle. Its convex side is grooved. It is glided under the bone to be removed—say the neck of the femur—and then by reversing its position its grooved surface is turned towards the bone and lifts it out of the wound, while its concave part lies over and protects the soft parts.

The use of Esmarch's bandage is, as I have said above, p. 941, very advantageous in most of these operations.

In late years, the advantages of preserving the periosteum ('subperiosteal or sub-capsulo-periosteal excision') have been much insisted on by Ollier and Langenbeck; and in some excisions they are incontestable, while in others the advantage of the new method is, at any rate, not as yet proved. I shall refer to the subject in speaking of each several excision.

Excision of the shoulder.

Excision of the shoulder is perhaps as successful as any, even that of the elbow, considered merely as an operation, and is equally applicable in cases of injury and disease; but it differs from excision of the elbow in the important particular that its results at their best are probably inferior—certainly not superior—to those of natural ankylosis, and therefore that it should never be practised when there is any good prospect of obtaining a cure by natural ankylosis. As this cure is very often obtained in case of disease of the shoulder, excision is but rarely practised in civil life. In gunshot injuries, when the missile has not penetrated beyond the bones of the joint, as in the cases figured on pp. 328-9, it is a very successful operation. In tumour springing fromt he head of the bone it might be justifiable to excise the affected portion of bone, if it could be clearly diagnosed that the tumour is not malignant, but this could very rarely be the case.

The operation, as usually practised, consists merely in removing the head of the humerus. This may be done, if there is not much thickening over the joint, by a single incision running downwards as far as maybe judged necessary from the upper part of the acromion process, over the most prominent part of the head, where it is most plainly felt beneath the skin. This line of incision corresponds pretty nearly to the direction of the long tendon of the biceps muscle. In some cases it is necessary to make a flap out of the deltoid muscle, of a somewhat triangular shape, with its base upwards. The

precise position of the incisions which bound this flap is a matter of secondary importance, and is usually determined by that of the sinuses or wounds. The head of the bone, having thus been exposed, is to be rotated (when the shaft is entire) first outwards, in order to stretch the tendon of the subscapularis, then inwards, to make tense those attached to the greater tuberosity; these tendons are to be divided, and the capsule thus freely opened, and then the head of the bone is to be thrust out of the wound and sawn off. If the case is one of injury, and the head of the bone is severed from the shaft, it must be seized with the lion-forceps and dissected out. The bleeding is usually free from the posterior circumflex artery or its branches. If the long tendon of the biceps can be distinguished it should be spared. In both disease and injury the glenoid cavity often escapes; but if it should be found affected, it may be thought necessary to remove it. This is best done with a large chisel or with bone-nippers of appropriate shape. The parts should be lightly put together by means of a few sutures, and the patient confined to bed for the first few days, until the consecutive fever has passed over. He may then be allowed to move about, the elbow being carefully supported. The tendency of the muscles which form the flaps of the axilla to displace the bone may be counteracted by a pad in the armpit.

Subperiosteal method.

The subperiosteal method should undoubtedly be adopted if the surgeon finds himself obliged to remove a great extent of bone. M. Ollier[1] directs that the incision should be made as far forwards as possible without wounding the cephalic vein, in order to retain the greater part of the deltoid muscle in its natural connection with the circumflex nerve, by which he hopes to preserve the action of that muscle. The joint is then to be cut into, and then all the tendons and periosteum peeled off the bones with raspatories of the proper shape, the humerus being gradually pushed out of the wound till the proper level is reached for its section.

I have never seen a case in which, after this excision, the arm could be elevated above a horizontal line, and this seems to me to depend more on the loss of the joint, and the consequent want of a point of support for the humerus, than on any supposed loss of function of the deltoid. In fact I believe that the atrophy of the deltoid is secondary on the loss of its function, and that if the machinery for raising the arm could be reproduced—that is to say, if the head of the humerus could be regenerated along with a perfect capsule, so that the ball could be firmly applied to its socket as in the natural condition—the deltoid would soon regain its bulk and power. But there is no proof given by M. Ollier's cases that this is ever done; and the mere ligamentous union which generally ensues furnishes no such fulcrum. At the same time, the shorter the ligament the more power of motion will there be in the humerus; and to this end it is very important to preserve the periosteum if the bone is to be divided much below the tuberosities. Many histories show the extensive excisions which may be practised on the humerus with preservation of a very useful arm. One published in the 'Lancet' for July 18, 1874, by Dr. Donovan, records a case in which the whole bone from the head to a point just above the condyles was excised subperiosteally, in a case of acute periostitis in a boy, with good results.

Excision of the scapula.

The excision of the scapula on account of a tumour is a formidable operation, the advantages of which should be maturely weighed before its dangers are encountered. Operations on this bone for necrosis are much more likely

[1] 'Traité des Régénérations des Os,' vol. ii.

to be permanently successful, but they rather resemble the common operations for extraction of a sequestrum than formal excisions.

The total excision of the scapula for a tumour should be thus performed. The patient being anæsthetised, an assistant should be charged with the compression of the subclavian artery, for which purpose, if the projection of the tumour makes compression difficult, the incisions may be so arranged as to enable him to put his finger directly down upon it. This precaution much diminishes the hæmorrhage from the subscapular artery and its branches, which otherwise might be formidable. The surgeon then proceeds to denude the tumour of its outer coverings by turning down appropriate skin-flaps, taking great care, however, not to open the capsule of the tumour itself.[1] When the whole tumour is thus exposed the muscles inserted into the vertebral border of the bone should be rapidly divided, as also those which are attached to the spine of the scapula. The tumour being now movable should be lifted well up, and freed from its other attachments by rapid strokes of the knife, commencing from its *lower* angle. The subscapular artery is divided near the end of the operation, and can be caught hold of by the surgeon or his assistant, and held till the tumour is removed, or can be at once tied. The ligaments of the shoulder are then easily divided and the mass removed. The acromion process, if not diseased, may be divided with bone-nippers, and left behind to preserve the shape of the parts and protect the head of the humerus.

Excision of the clavicle.

Excisions of any part of the clavicle should be undertaken with the greatest care on account of the close relations which the bone has to important structures, and on account of the risk of diffuse inflammation below the deep fascia of the neck; and the total extirpation of the bone for a tumour springing from its substance, is one of the gravest operations in surgery. In Mott's case the operation lasted *four hours*, and thirty vessels were tied. Mott says: 'This operation far surpassed, in tediousness, difficulty, and danger, anything which I have ever witnessed or performed.' If it be decided to remove the whole clavicle along with a tumour, the incisions should be made very free, one over the long axis of the bone, joined by others in appropriate places for turning down such flaps as may appear necessary, and the parts to be operated on should be brought fairly into view before the bone is meddled with. After having freely divided all the superficial attachments of the bone and tumour, the next step is to divide the outer end of the clavicle from the scapula, either by cutting through the joint or by severing the bone with a small saw or nippers. Then the part which is to be removed can be raised, and must be separated with great care from the important parts which lie below it, so as to reach the sternal part, which is last divided, and which serves during the operation as a pivot on which the bone can be moved and supported; or, in other cases, it may be found more convenient to divide this part of the bone also at an earlier period of the operation.[2] It appears that very useful motion may be recovered after the removal of a large part, or even the whole, of the shaft of the clavicle.

Excision of the elbow.

Excision of the elbow is a most useful and a most successful operation. It is practised on account of injury and of disease with equal relative success, though the absolute success is, as in all operations, much greater in cases of

[1] See Pollock, in 'St. George's Hospital Reports,' vol. iv. p. 237.

[2] See Travers, 'Med.-Chir. Trans.' vol. xxi.

disease than those of injury. Any disease which does not extend far from the articulating surfaces, and which is otherwise incurable, is a clear indication for excision. As caries of the joint-ends of the elbow hardly ever involves any extensive inflammation of the shafts of the bones, this comprises most cases of serious disease of this joint. There are even cases in which the disease is not incurable, but where the cure would involve long disuse of the limb and ultimate loss of motion from ankylosis, where it may be justifiable to resort to excision, if the patient be young and healthy, in the hope of cutting short the disease and procuring a more movable limb. And other cases are also met with, though rarely, in which the limb has been allowed to become ankylosed in an extended or otherwise useless position, and where the surgeon may be justified in excising the joint at the request of his patient after the risks and the probable advantages of the operation have been explained to him.

It must always be borne in mind in this operation that the object is to procure such union as shall be sufficiently firm to afford a fixed centre of motion for the bones of the forearm, and thus give precision and strength to the movements of the hand, and yet shall not be so close as to abolish any of the motions of the joint. In the most successful cases these indications are perfectly fulfilled, so that the motions of the hand are as extensive as on the sound side, and no case of excision of the elbow is to be reckoned as perfectly successful in which this freedom of motion has not been obtained. Such perfect success is more probable in childhood than in mature life, though even then it is often obtained, and if it be not, an amount of motion ought at any rate to be insured which leaves the patient a very useful arm even in cases which do not quite come up to the ideal.

The operation is now almost always performed by means of a single straight incision running parallel to the course of the ulnar nerve, but a little external to it—i.e. over the inner side of the olecranon and for about two inches above and below it. This incision is made fairly down to the bone, dividing the triceps muscle and the periosteum. The operator proceeds differently in the common and in the subperiosteal operation. In the ordinary operation he opens the joint freely by cutting round the olecranon, divides the external lateral ligament, dissects the parts off the humerus between the olecranon and internal condyle with much care, keeping the edge of the knife constantly on the bone, and pressing the parts away from the bone with the left thumb-nail cautiously so as not to endanger the ulnar nerve which lies amongst these parts.[1] Then the internal lateral ligament is cut away from the humerus, and now the joint is quite destroyed. If the end of the humerus can be thrust out of the wound without interfering with the bones of the forearm it is to be sawn across just above the condyles, or the olecranon may be cut away for this purpose before the rest of the disease is removed from the forearm. Then the bones of the forearm are to be thrust out of the wound and sawn off on the same level—i.e. just below the coronoid process, the head and neck, but not the bicipital tubercle of the radius being removed. It is far better to remove both bones together by a clean cut with a saw than to divide the neck of the radius with bone-nippers. And it is often convenient to reverse the usual order, by removing the bones of the forearm before dealing with the humerus. When the surgeon is satisfied that all the disease is re-

[1] The ulnar nerve is seen in operations on the dead subject, but in disease it is seldom visible, being hidden by the inflammatory products around the diseased joint. I have seen it in primary excision for injury in the living, and in excisions in which Esmarch's bandage is used it may sometimes be seen.

moved, the bandage is relaxed (if, as is generally advisable, Esmarch's bandage has been employed), and the vessels tied with catgut ligatures. Then a few minutes are to be given for exposure and cold-bathing to stay any residual oozing, the wound is to be united with silver sutures, a drainage tube being inserted into it, and the arm put on a splint and dressed.

Subperiosteal method.

If the operator decide to proceed subperiosteally he must first take care that his incision has really divided the whole periosteum down to the bony structure, then by working with the raspatory on the back of the olecranon he will find it very easy to detach the periosteum there, and he must use all possible care to clean the back of the humerus completely of all soft structure—periosteum, capsule of joint, and tendons—and especially to detach as

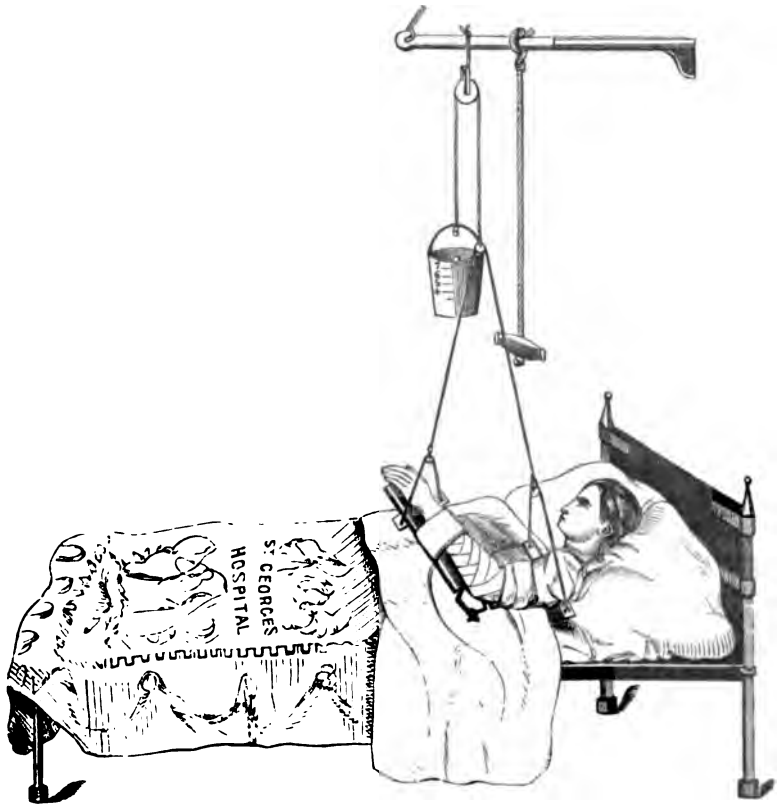


Fig. 411. The method of slinging the limb after excision of the elbow.

completely, and with as little injury as possible to their structure, all the tendons and other soft parts which adhere to both condyles. The end of the olecranon may now be removed in order to obtain access to the front of the ulna, detach the tendon from the coronoid process, and thus complete the denudation of the portion of the ulna which is to be sawn off. If the attachments of the orbicular ligament can be recognised and preserved it may be possible to remove the head of the radius without interfering with them. Now comes the most difficult part of the operation—viz. how to clean the front of the humerus of its periosteum. M. Ollier attempts this by gliding a curved instrument between the bone and periosteum and conveying a chain saw in its course; but this curved raspatory is very apt, when acting in the

dark, to pass through the periosteum. It seems better to divide the bone with the keyhole saw from behind incompletely, and then fracture it, as is done by some operators while removing the end of the femur in excising the knee. The periosteum will remain untorn, and the surgeon can then proceed to detach it from either side, commencing from the part exposed in the wound. The advantages of the subperiosteal excision of the elbow, which is far more laborious and involves more violence to the tissues than the common operation, are, I must say, as yet unproved.

After the operation, the limb should be placed lightly on a splint. The precise form of splint is of no importance; in fact, the splint itself is not absolutely necessary, for some surgeons of much experience use only a bandage. But I think the support and confidence which the splint gives are a great comfort to the patient, especially if startings of the limb take place, as they are rather apt to do. In about a week, when the parts are beginning to consolidate, the splint should be so arranged as to permit the hand to reach the mouth, and when the wound has nearly healed passive motion and then active motion is to be enforced. The precise time at which active motion is to begin cannot be fixed. If the quantity of bone prescribed above has been removed, there will very likely never be occasion for any passive motion at all, and in no case ought it to be used until all active inflammation has passed over and the wound is almost healed. While the patient is in bed it is a comfort to sling the arm from a pole over the bed, as shown in Fig. 411.



FIG. 413. Mr. Syme's case of reproduction of the joint after excision of the elbow. From the 'Lancet,' vol. i. 1855. *a*, the humerus; *b*, the ulna; *c*, the radius; *d*, *e*, projections from the shaft of the humerus locking in the bones of the fore-arm in the new joint; *f*, new orbicular ligament around the head of the radius; *g*, a portion of the ligamentous union between the ulna and humerus; *h*, tendon of the biceps; *i*, *k*, new lateral ligaments attached below to the end of the ulna on the one side, and to the orbicular ligament on the other.

Repair after excision of the elbow.

The repair after excision is in rare cases by bony ankylosis. This is undoubtedly to be reckoned as a failure, and ought hardly ever to occur. It depends generally on the removal of too little bone, and on the neglect of passive motion afterwards. Commonly the repair is by means of fibrous bands which tie the ends of the different bones to each other. In rare cases there is considerable reproduction of bone and a complete joint is formed. This was the case in a remarkable instance described and figured by Mr. Syme, in which a considerable reproduction of bone had taken place from either side of the end of the humerus, and these two newly produced condyles locked in the two bones of the forearm, forming a complete hinge joint in which the radius played in a newly-formed orbicular ligament. The patient, who was a railway guard, had been able to use the excised elbow as well as the sound one for the purpose of swinging himself from one carriage to another of the train in motion. This reproduction is quite as perfect as any which has been proved to take place after subperiosteal resection. In fact the reproduced bone after the latter operation is often exuberant and is detrimental to the motion of the joint.[1]

[1] A very interesting account of the dissection of a case four years after subperiosteal resection will be found in Langenbeck's 'Archiv,' vol. x., by Dr. Doutrelepont, and another,

The danger to life of excision of the elbow is trifling, especially when performed for disease. Of thirty-one successive excisions of the elbow for disease recorded in the St. George's Hospital Reports, performed at all ages from three to thirty-seven (six only being below fifteen years) and in very various states of health, none died, and only one, at most, suffered amputation. ('Syst. of Surg.' 3rd ed. vol. iii. p. 748.)

Excision of the wrist.

Excision of the wrist as a formal operation is not often practised, since in cases of disease which are sufficiently serious to justify so very severe a proceeding, the affection has generally extended too far; while in slighter cases, the surgeon thinks that the patient will ultimately do better if only the diseased portions of bone be dealt with from time to time as may be necessary, and passive motion be kept up sedulously. In cases of injury I have never as yet heard of excision being practised.

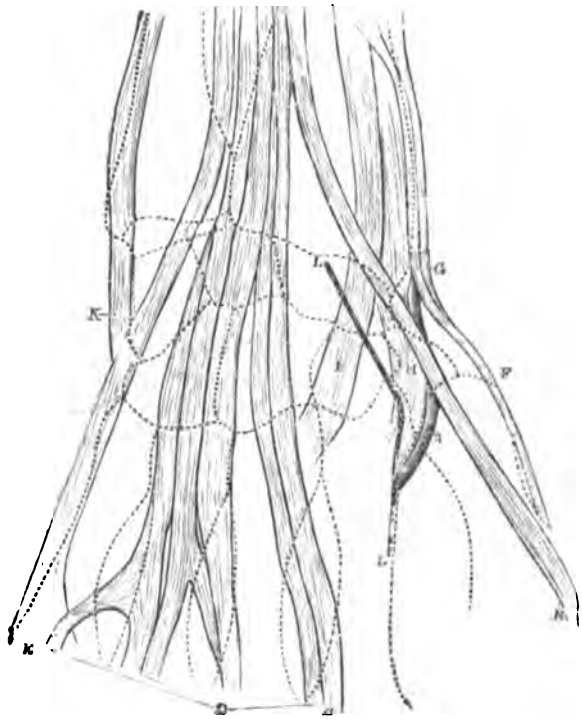


Fig. 413. Diagram of excision of the wrist (after Lister). A, The radial artery. B, Tendon of the extensor secundi internodii pollicis. C, Indicator. D, Ext. comm. digitorum. K, Ext. min. dig. F, Ext. prim. int. pol. G, Ext oss. met. pol. H, I, Ext. carp. rad. long. and brev. K, Ext. carp. uln. L L, Line of radial incision.—From the 'Syst. of Surg.'

The two chief objects in the operation of excision of the wrist are not to divide any tendons which can be spared, and to remove the whole joint, i.e. the ends of the bones of the forearm, all the bones of the carpus (except perhaps the pisiform), and the ends of all the metacarpal bones. This is best done according to Professor Lister's method, which is thus effected. The patient is placed under anæsthesia, and then the bandage or tourniquet being securely adapted, an incision is made commencing in front over the second metacarpal bone internal to the tendon of the extensor secundi internodii pollicis, and running along the back of the carpus, internal to the same tendon, as high as to the base of the styloid process of the radius. The soft parts, including the extensor secundi internodii and the radial artery, being cautiously detached from the bones external to this incision, and the tendons of the radial extensors of the wrist being also severed from their attachments, the external bones of the carpus will be exposed. When this has been done sufficiently,

still more interesting and complete, by Dr. Cheever in the 2nd series of 'Med. and Surg. Reports' of the Boston (U.S.) City Hospital. Both are illustrated by drawings of the reproduced articulations. I would refer to my essay in the 'Syst. of Surg.' 3rd ed. vol. iii. p. 744, for a discussion of the alleged advantages of the subperiosteal operation.

the next step is to sever the trapezium from the other bones with cutting pliers, in order to facilitate the removal of the latter, which should be done as freely as is found convenient. The operator now turns to the ulnar side of the incision and cleans the carpal and metacarpal bones as much as can be done easily. The ulnar incision is now made. It should be very free, extending from about two inches above the styloid process down to the middle of the fifth metacarpal bone, and lying near the anterior edge of the ulna. The dorsal line of this incision is then raised along with the tendon of the extensor carpi ulnaris, which should not be isolated from the skin and should be cut as near its insertion as possible. Then the common extensor tendons should be raised, and the whole of the posterior aspect of the carpus denuded, until the two wounds communicate quite freely together; but the radius is not as yet cleaned. The next step is to clean the anterior aspect of the ulna and carpus, in doing which the pisiform bone and the hooked process of the unciform are severed from the rest of the carpus, the former with the knife the latter with the cutting-pliers. In cleaning the anterior aspect of the carpus, care must be taken not to go so far forwards as to endanger the deep palmar arch. Now, the ligaments of the internal carpal bones being sufficiently divided, they are to be removed with blunt bone-forceps. Next, the end of the ulna is made to protrude from the incision and is sawn off, as low down as is consistent with its condition, but in any case above its radial articulation. The end of the radius is then cleaned sufficiently to allow of its being protruded and removed. If this can be done without disturbing the tendons from their grooves, it is far better. If the level of the section is below the upper part of the cartilaginous facet for the ulna, the remainder of the cartilage must be cut away with the pliers. The operator next attends to the metacarpal bones, which are pushed out from one or the other incision and cut off with the pliers, so as to remove the whole of their cartilage-covered portions. The trapezium bone, which was left in the early stage of the operation, is now carefully dissected out, so as to avoid any injury to the tendon of the flexor carpi radialis or to the radial artery, and the articular surface of the first metacarpal bone is then exposed and removed. Lastly, the cartilaginous portion of the pisiform bone is taken away; but the non-articular part is left behind unless it is diseased, in which case it should be removed entire. The same remark applies to the hooked process of the unciform.

The operation is one of the most tedious and difficult in surgery, but it appears to me to give very satisfactory results, and therefore should, I think, always be adopted in such cases as are favourable for any operation at all. It is advisable, if not necessary, to put on the tourniquet, or Esmarch's bandage, so that the view of the parts should not be obscured by blood. It is also very desirable to break down freely any adhesions which the tendons may have formed, while the patient is under anæsthesia previous to the operation.

No tendons are divided in this operation except the extensors of the wrist, for the flexor carpi radialis is inserted lower down than the point at which the metacarpal bone is divided.

In order to insure motion, particularly in the fingers, passive movements should be performed from a very early period after the operation. For this purpose, Sir J. Lister places the limb on a splint with the palm of the hand raised by a large wedge of cork, fixed below it; so that the joints of the fingers can be moved without taking the limb off the apparatus. Special arrangements are made for keeping the splint steady and for preventing displacement of the hand to either side. Careful and methodical passive motion should be

used to each several joint—to those of the fingers and thumb almost from the day of operation, and to the wrist as soon as the parts have acquired some firmness, each movement, pronation and supination, flexion and extension, abduction and adduction, being separately exercised; and the patient should be encouraged to make attempts at voluntary motion as early as possible. In order to exercise the fingers, the portion of the splint which supports them may be removed while that on which the wrist is received is still left. Finally, when the rigid splint is left off, some flexible support is still to be worn for a long time.

Excision of the hip.

Excision of the hip is performed almost exclusively on account of strumous disease (so-called) of the joint. The few cases in which this operation has been practised for gunshot injuries have, I believe, all occurred in military practice, and they have been exceedingly fatal.[1]

I have spoken in the appropriate place (p. 476) of the indications for performing this operation in morbus coxarius, and have now only to deal with the operative details. Some operators content themselves with removing only so much of the femur as is diseased; others (as Dr. Sayre of New York) consider it necessary to remove the whole of the trochanter major. The latter plan seems to me to involve an unnecessarily extensive removal of bone; but if it is preferred I have no doubt that the subperiosteal method should be followed, as recommended by Dr. Sayre. The ordinary operation is thus performed. A free incision is made, of a semilunar shape with the convexity backwards, over the posterior part of the trochanter, which should go boldly down to the bone. Then by cutting along the neck of the femur the joint is reached,[2] and it should be freely opened; the head of the bone twisted out of the joint, and the neck divided, with a keyhole saw, as low down as the surgeon thinks necessary. If the operation is performed for injury and the neck of the bone is fractured, the incisions must be more extensive, the fractured part must be freely exposed, seized with the lion-forceps and dissected out, and then search must be made for bullets, fragments of bone, and other foreign bodies. Finally, the surgeon must carefully examine the acetabulum and remove by the gouge, trephine, chisel and forceps all portions of diseased bone. In the subperiosteal resection, the periosteum is divided just below the great trochanter, and that process is denuded from all fibrous tissue (periosteum and tendons) inserted into it, and this proceeding is carried on upwards till the joint has been laid freely open. Then the common tendon of the psoas and iliacus is divided with a knife and the deep portions of the neck of the bone separated from the fibrous structures as well as it is possible.

Subperiosteal method.

It is usual in Europe to dress the wound lightly, and either put up the limb in a bracketed splint, or in a plaster of Paris case, or—which I have found easier and quite as satisfactory—with a weight and pulley. None of

[1] Prof. Volkmann, in a lecture translated for the 'New. Syd. Soc.' (German Clinical Lectures, p. 404), says that the experience of gunshot injuries of the hip-joint accumulated in the American Civil War, and in the Prusso-Austrian and Franco-German wars, shows that nearly all such cases prove fatal, however treated, and that, although it is quite exceptional for a patient to recover after excision, yet the results of a purely conservative treatment have hitherto been no better—even slightly worse. See Longmore in 'Syst. of Surg.' 3rd ed. vol. i. pp. 559–560.

[2] Though the joint in advanced stages of disease is usually spoken of as 'dislocated,' it really hardly ever is so. Having excised the hip-joint more than thirty times I cannot remember to have come across a case in which the head of the bone (or its remains) was not in the acetabulum, and Dr. Sayre says that in fifty-two cases of excision he has only found one of dislocation.

these plans aim at restoring the length of the limb. Dr. Sayre's plan consists in screwing the limb down by means of an extending apparatus to the same length as the other, and he asserts that in some cases, after removing a great length of bone, the limb has regained its normal length, and all its natural movements.

The operation is a dangerous one; at least a great many patients die after it: many, it is true, not from the operation but from previous disease. Still the number who have died from the direct sequelæ of the operation has not been small, in my experience. Nearly half of the published cases seem to have proved fatal, from one cause or another.

The limb is often an extremely useful one; but I think it is true that the natural cure by ankylosis leaves a limb, which though perhaps more deformed, is as a rule firmer and stronger than that left by excision. On this subject, and on the relative prospects of cure by the expectant and the operative treatment, much light has been thrown by the report of a committee of the Clinical Society, to which I would refer, in the fourteenth volume of their Transactions.

Union is almost always by ligament;[1] in some rare cases, chiefly those which have been neglected, osseous ankylosis has taken place; in others no union has occurred, or the femur has been so loosely connected to the pelvis that the limb is useless.

Excision of the knee is an operation which has afforded excellent results in the less severe cases of disease of the synovial membrane and articular surfaces of that joint, for which amputation used to be performed. By 'the less severe cases' I mean such as occur in young persons of a tolerably healthy constitution, from chronic action, not spreading to any great extent into the bone, and not accompanied with very great distortion or atrophy of the limb. It is quite true that in many of these cases, if no operation be performed, the abscesses will dry up and the diseased bone exfoliate ultimately: but it is also true that this action often takes many years to accomplish, during the whole of which time the patient is unfit for any active employment, and that often at the end of it the limb is more an encumbrance than anything else, and frequently requires amputation. However this may be, it is certain that we used some years ago to see amputation practised in many of the same class of cases as are now treated most successfully by excision, and so far excision of the knee has been a great gain. But the attempt to show that it is in itself a safer and more successful operation than amputation has failed, and all judicious surgeons now agree that excision cannot be successfully performed above the middle period of life (say about forty, varying, however, of course with the constitution) or in phthisical patients, or in acute or extensive disease, or for tumours, in all which conditions amputation though dangerous is often successful.

Excision is also very dangerous when performed as a primary operation for injury, and especially those complicated injuries which follow on gunshot wounds, so that in these amputation is usually preferred, unless under exceptional circumstances—that is to say, in persons of remarkably sound constitution, or at early periods of life, and in whom the injury can be ascertained to be strictly limited to the immediate neighbourhood of the articulation.

The operation is thus performed. An incision should be made from the back part of one condyle to the back part of the others, passing across the front of the limb below the patella, and slightly convex downwards. It is

[1] 'Syst. of Surg.' 3rd ed. vol. iii. p. 757.

seldom necessary to make any other incision into the skin;[1] but if there is much thickening about the soft parts, perpendicular incisions may be made at the ends of this, so as to form the H-shaped incision, which used always to be employed in this operation. The ligamentum patellæ is to be divided in the first incision; then the soft parts are to be thrown back from the patella and the end of the femur, and the patella is to be removed.[2] The joint is now to be freely opened by cutting at the sides of the condyles, so as to sever completely both lateral ligaments; and then the knife is to be carried round the posterior surface of the end of the femur, care being taken in doing this to thrust the femur out of the wound as much as possible, by an assistant forcibly flexing the limb, and to keep the edge of the knife directed towards

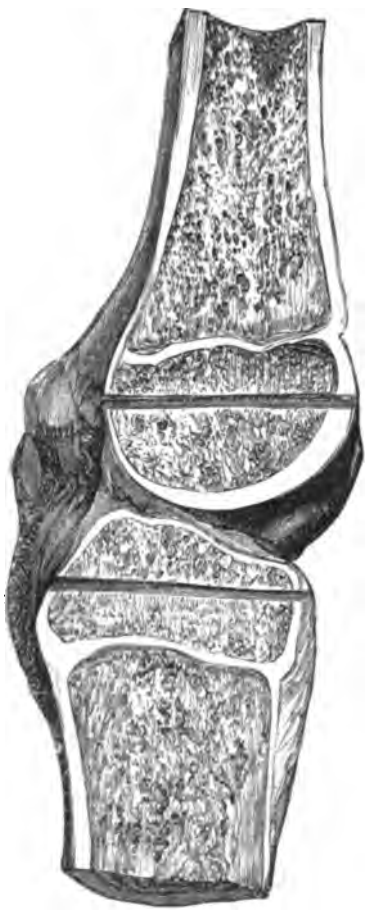


FIG. 414. A section made through the femur and tibia in a child aged five years, to show the position of the epiphysial lines and the point at which the section ought to be made in excision. If the section be made above the trochlear surface of the femur, the whole epiphysis will be removed. In the tibia, the whole articular surface may be removed without risk.—From the 'Syst. of Surg.'



FIG. 415. The same femur, shown in an anterior view, to mark the level at which the saw ought to be applied.

the bone, and guided by the finger, so as to avoid the popliteal artery, which here is separated from the bone only by some fat and loose tissue; and, in

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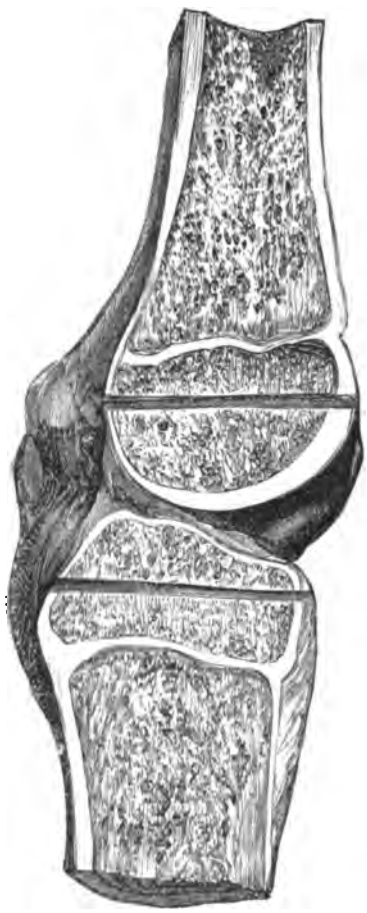


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[1] Some surgeons prefer to make a long elliptical flap from the front of the limb, including the patella. I myself do not ordinarily use this method, as it makes a larger wound and renders it somewhat more difficult to deal with the patella. It may, however, be necessary when there is much swelling.

[2] It is my invariable rule to remove the patella, and this is, I believe, the usual practice. I can see no use in the bone if left, and much risk of recurrence of disease. (See also Swain, 'On Excision of the Knee-joint,' p. 73.) Dr. Patrick Heron Watson, on the other hand, counsels its preservation, when possible, for the following reasons: '(1) That its removal is unnecessary in most cases; (2) that its presence in the flap bears up the soft parts from the line of incision, and without preventing consolidation, helps to keep them away from the cut

sawing the bone it may be advisable if the femur have not been very completely cleaned, not to pass the saw entirely through the osseous tissue, but rather to break than to cut the outer lamella at the back, by using the saw as a lever. The level at which the femur is to be divided should be carefully borne in mind in operating on children. I have repeatedly seen the surgeon take away the whole epiphysis, and a part of the shaft from mere want of care, having forgotten, or omitted to ascertain, whereabouts this line is situated. Figs. 414, 415, show its true position, and will prove that in any case of excision in which the whole cartilaginous surface of the femur is removed, the shaft will be trenched upon. The end of the femur having been removed, the head of the tibia is to be cleaned and sawn horizontally, care being taken in young persons to keep close below the cartilaginous surface, so that the epiphysial line be not interfered with. In cases where there has been no dislocation, nor much alteration in the shape of the bones from previous disease, there is now usually no impediment to placing the limb in a straight position, with the bones in accurate adjustment. Otherwise they must be adjusted by taking off successive pieces from the end of the femur or tibia (if possible without going beyond the epiphysis); and in cases of old dislocation it is often necessary to sever some of the hamstring tendons. The parts should, in all cases, be adjusted in perfect position upon a splint, and the bandages firmly applied before the patient is moved or allowed to recover from the anæsthetic. If the femur appears at all prominent, a short splint should be applied in front in order to counteract the tendency of the leg to gravitate backwards (which is also assisted by the action of the flexor tendons); and it is at any rate a useful precaution to apply a long side-splint to the outer side of the limb, which can be discarded after the first few days, if it appears superfluous. I have found much comfort to the patient from suspending the whole apparatus in a 'Salter's swing.' It will of course be understood that the splints are interrupted and bracketed with iron at the seat of operation, so as to give access to the wound.

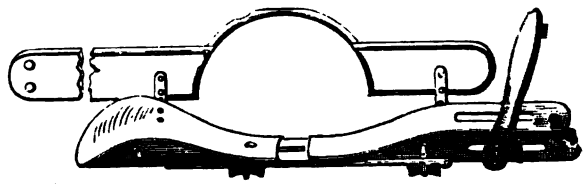


FIG. 416. Splint for excision of the knee.

Mr. Treves, of Margate, thus describes a method of excising the knee, in which the tendon of the quadriceps extensor is left in its natural attachment to the tibia. I have myself no personal experience of this method, but it seems worthy of a trial:—

'*First.* A semilunar incision about three inches in length is made on each side of the joint, the lowest point of each incision being thoroughly dependent for the exit of pus or serum.

margin of either osseous surface; (3) that its removal occasions more bleeding; and (4) that the hollow left after its removal from the centre of the long flap leaves a hollow cavity, in which matter bags, and requires a separate incision to drain it efficiently.' ('On Excision of the Knee,' p. 76.) If the latter assertion be well-founded, it constitutes to my mind an additional objection to the use of the long flap in excision, rather than an argument for the preservation of the patella. None of the other supposed inconveniences of removing the patella will be found to be of any practical importance, if the operation be performed with the simple transverse incision. As to the first assertion, it is a matter of experience. In my own practice, the removal of the patella has seemed in the great majority of cases not merely advisable, but necessary. In the 'Clin. Trans.' vol. xvi. p. 82, Mr. Golding Bird describes a method of excising the knee, in which the patella is sawn across, and its fragments sewn together after the completion of the excision ('transpatellar excision').

'*Secondly*. The lateral ligaments on each side are divided, and the tissues reflected, till the synovial cavity in front is well opened. If there be adhesions in front they are divided. A wide director is passed behind the joint in front of the posterior ligament, and with a narrow bistoury the crucial ligaments and any adhesions there may be between the bones are divided.

'*Thirdly*. A metal retractor is inserted in front of the bones to secure from injury the tissues in front and the skin and tissues loosened from the sides whilst the bones are being sawn. The blade of a Butcher's saw is passed behind the joint; and this being connected with its frame, a thin slice is sawn from the joint-ends of each bone. The sawn surface of this slice is the exact counterpart of the surface left behind; and if, on examination, it appear to be healthy, I pass on to the patella, which is left if healthy, or sliced if its cartilage be ulcerated. I formerly used a chain-saw for the sections, but have relinquished it in favour of Butcher's.

'The following are the chief advantages to be derived from this mode of operating:—

'1. Decided improvement in the after-appearance of the limb. The front view shows little difference from the other limb.

'2. Greatly increased power of extension. After ordinary excision, extension is often feeble from the divided and shortened extensor tendon; the leg is inclined to drag and the patient catches his toe in walking. With this operation, they are able to lift the leg even before union is firm; and they get increased advantage from the additional power and handiness of the limb.

'3. The extensor tendon being still attached to the tibia in front, whilst the posterior ligament is intact behind, the bones are not so loose and the tibia is not so likely to become displaced.

'4. This mode of operating partakes of the nature of a subcutaneous operation. The sawn surfaces are still left under their natural covering; they are not exposed under an extensive wound, which will sometimes gape in spite of care; but, being well protected, they unite, I believe, more kindly and readily than with the usual operation. I may add that this is, after a little practice, a very easy operation.'[1]

In an interesting brochure lately published by Dr. Fenwick of Montreal,[2] which contains a report of twenty-eight cases of this excision, he advocates a curved section of the bones, so that the sawn end of the femur is left convex and that of the tibia concave, whereby not only are the bones better adapted to each other, and less likely to become displaced, but also the epiphysial lines are nowise endangered. A similar plan was, I believe, adopted by the late Mr. Moore and Mr. Campbell de Morgan.

Many methods of dressing the wound and limb in cases of excision of the knee are in use. Dr. Patrick Heron Watson warmly recommends the use of



Fig. 417. Dr. P. H. Watson's suspension-rod for excision of the knee.

plaster of Paris (or plaster coated with paraffine externally, to render it less permeable to discharges), which he thus applies. Fig. 417 represents an iron rod, which extends from the groin to the foot, the upper straight end being at the groin, the arch at the site of the wound, the hook (for swinging

[1] 'Brit. Med. Journ.' Feb. 3, 1877.

[2] 'On Excision of the Knee-joint,' Montreal, 1883.

the limb) near the ankle-joint, and the raised part running along the dorsum of the foot. Fig. 418 shows two forms of 'Gooch' splint, the former merely hollowed out on each side at the level of the wound and cut out at the lower part in a horse-shoe or stirrup form, to relieve the heel and tendo Achillis from pressure; the latter having also a piece above to be adapted to the innominate bone.

'In application, the limb is first laid and carefully adjusted upon the posterior splint, which should preliminarily be padded with lint, and covered with guttapercha tissue, or hot paraffine, in the position which corresponds to the site of operation. The iron rod is then placed in front, and folded lint laid between it and the limb at the groin, at the upper part of the tibia, and at the bend of the ankle. These two parts of the apparatus are then retained

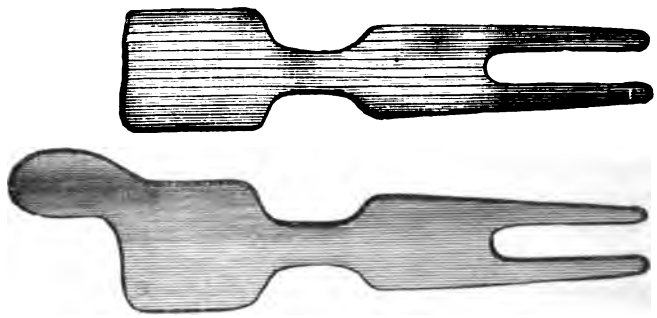


FIG. 418. Dr. P. H. Watson's splints for excision of the knee.

in contact with the limb by means of an *open wove* roller bandage applied from the toes upwards, the site of the incision being alone left uncovered. The whole is then rendered immovable by means either of plaster of Paris applied by the hand, of the consistence of thick cream, or of paraffine, which having been rendered temporarily liquid by heat, is applied by a large painter's brush. When the application has solidified, the patient may be removed to bed, and the limb suspended from the running pulley of a Salter's swinging cradle, or from the roof-bar of the common iron wire cradle.' (Op. cit. p. 19.)

The advantages claimed for this method are the comfort the patient derives from being able to shift his position; the ease of transporting him from place to place (a great consideration in military practice); the facility of applying dressings to the wound; the permanency, simplicity, and facility of construction of the apparatus itself. The plaster of Paris dressing is in general use in this and other excisions by the German surgeons.

Mr. Butcher has recommended[1] a 'box splint' for the after-treatment of this operation. This consists of two side-splints, the outer one extending from the axilla to below the foot, the inner from the groin to below the foot, jointed on to a back piece. The sides are let down to dress the wound. This is, as far as I have seen, a convenient apparatus when all goes well, but is less handy when complications occur, and is, on the whole, I think, inferior to the above-mentioned methods of treatment.

It is an essential element in the success of this operation not to be forced to disturb the limb at all for several days; hence the dressings should be most carefully applied at first. And for the same reason all bleeding vessels should be carefully secured so as to avoid recurrent hæmorrhage. The bleeding during the operation is often very free, from the enlarged articular vessels; and recurrent hæmorrhage is by no means rare, and is a very un-

[1] 'Operative and Conservative Surgery,' p. 142.

favourable occurrence. The operation, especially when it has been a protracted one, which in cases of old dislocation it often is, is usually followed by a considerable amount of fever, subsiding with the establishment of a free suppuration; and then, in favourable cases, the work of repair commences by granulation and osseous union, as in compound fracture. In unfavourable cases, the bones become denuded and ulcerated in the suppurating cavity, the discharge is offensive, the wound unhealthy, fresh abscesses probably form, and the patient's health, instead of improving from the removal of the disease, shows a tendency to decline. Under these circumstances amputation should be performed, if an examination under anæsthesia proves it necessary.

The process of recovery is usually a slow one. In Dr. Hodges' tables the average duration of the treatment in 48 cases in which the patella was removed is stated to have been 225 days; and in 88 cases in which that bone is believed to have been left, 255 days; or, roughly speaking, the average duration of treatment was about eight months; and in many of the cases which afterwards turn out the most successful, sinuses remain open, and the limb is in a state which cannot but cause anxiety for many months after formal treatment is discontinued. In some exceptional cases, indeed, matters go on much more rapidly than this, and the recovery is completed as soon as (indeed it may be that one or two have recovered sooner than) after amputation; but, as a general rule, the time required for recovery after excision may be taken at about four times as long as after amputation. In fact, I think we are taking a view very favourable to excision if we say that every month after the operation advances the cure only as far as a week would after amputation.

Repair, when the case does perfectly well, is by osseous ankylosis, and this ought to be complete, so that the tibia and femur form one solid mass of bone in a perfectly straight line.[1] There is a great tendency to bow outwards at the junction, and this must be carefully watched and counteracted during the process of healing, and for some time after the patient begins to put his leg to the ground. In rarer cases the limb bends backwards[2] or inwards, but the outward bend is the more common. In some cases small portions of bone remain long exposed, and the wound cannot be brought to heal. Such cases may often be treated successfully by gouging or by treating the exposed bone with sulphuric acid.

Excision of the ankle-joint is an operation which is not often practised, since in injury it is usually sufficient to take away the loose or comminuted portions of bone, and in disease the affection is seldom so limited to the ankle as to justify the surgeon in removing only that joint. Excision of the ankle.

Cases suitable for excision of the ankle are those in which the lesion (whether traumatic or from disease) is limited to the ends of the bones of the leg and to the astragalus. When the disintegration extends far into the bones of the leg, amputation ought undoubtedly to be practised, and although in some cases a considerable amount of the bones of the tarsus has been successfully removed along with the ankle-joint,[3] yet the advisability of such an operation must always be very doubtful. Again, the patient ought not to be labouring under any general constitutional cachexia; and further, those

[1] Cases sometimes occur in which a certain amount of motion is preserved, and Mr. Annandale has reported a remarkable one in the 'Brit. Med. Journ.' April 21, 1877, but I think no one now doubts that the aim of the surgeon should be to obtain osseous union.

[2] As in a preparation in the Museum of the College of Surgeons, where bony ankylosis has taken place at a right angle.

[3] See my essay, 'On Excision of Bones and Joints,' in the 'Syst. of Surg.'

cases are best suited for this excision in which the disease is the direct result of a somewhat recent injury. With all these limitations, the range of application of this operation will be but small in cases of disease, and in those of injury, as above stated, partial resections have hitherto been more common; but there is much reason to believe, with Mr. H. Lee, that in these cases a more useful limb would often be obtained by a more formal excision of the whole joint.[1]

The operation is not an easy one, and it is rendered more difficult in some cases by partial ankylosis. The best way of performing it is, I think, to make a free incision behind the posterior border and external malleolus of the fibula, extending about two inches along the outer side of the foot, and a smaller incision, as recommended by Mr. H. Lee (op. cit.) round the internal malleolus. The inner malleolus, having been carefully cleaned of soft parts, is to be partially sawn through with a Hey's saw, and clipped off with bone-nippers. Then the external malleolus, having been dissected clear of the tendons and other fibrous structures, is to be sawn through, and now by clearing the bones of all their fibrous adhesions, the tibia may be pushed out of the wound on the outer side of the foot, and its articular end sawn off. Next the astragalus is to be dealt with. In all cases where the bone is much inflamed it is much more satisfactory (as I think I have proved[2]) to remove the whole bone, for which purpose the astragalo-scaphoid joint should be freely opened; then the knife passed between the astragalus and os calcis, dividing the interosseous ligament; and finally, the bone twisted out with the lion-forceps. But if the affection of the astragalus be very superficial, a keyhole saw may be passed into the wound, either in front of or behind the articular surface, and the whole of this surface removed by a horizontal section. No large vessel should be wounded in this operation, nor are any tendons necessarily divided.

A much easier operation is to make an anterior flap through all the tendons, nerves, and vessels in front of the joint, as in Syme's amputation, and then remove all the diseased parts of the bones; but as this involves needless injury to the anterior tibial vessels, and division of several tendons, it is not often resorted to. At the same time, I have excised the astragalus in this way several times, and the use of the foot has been very good, notwithstanding the injury to the tendons and vessels.

A well-fitting splint should have been previously provided, and the limb should be kept at rest till the parts have become quite consolidated. It is then to be put into a plaster or other immovable apparatus, and the patient is to be allowed to walk about on a wooden leg.

The use of the leg is often almost as good as ever. Two lads on whom I performed this operation, removing the astragalus wholly in one and partially in the other, were heard of some years afterwards doing the ordinary work of agricultural labourers, and able to walk all day; but recovery is much slower than after amputation.

Excision of the os calcis.

Excision of the os calcis is an operation which may often be practised with great advantage. Disease of the tarsus very commonly begins in the joint between the calcaneum and astragalus, and frequently spreads into the former bone; the affection of the latter being so superficial that the carious spot can be gouged away when the greater mass of disease has been removed. In these cases the central part of the calcaneum often perishes, leaving a large mass of necrosis enclosed in a thin-walled cavity of inflamed and softened

[1] See a paper by Mr. H. Lee, in 'Med.-Chir. Trans.' vol. lvii. p. 137.

[2] See 'St. George's Hospital Reports,' vol. iv. 'A Note on Excision of the Ankle-joint.'

bone. If now the whole bone, including the shell of softened bone, be removed, the patient makes a certain and speedy recovery with a useful foot; while if the loose portion be removed, and the shell scooped, he may, it is true, recover, and the heel may possibly be more firm, but the recovery is at least doubtful, and in the course of a tedious convalescence the health may give way, fresh disease be lighted up, and amputation become necessary.

Excision of the os calcis is thus performed. An incision is commenced at the inner edge of the tendo Achillis, and drawn horizontally forwards along the outer side of the foot, somewhat in front of the calcaneo-cuboid joint, which lies midway between the outer malleolus and the end of the fifth metatarsal bone. This incision should go down at once upon the bone, so that the tendon should be felt to snap as the incision is commenced. It should be as nearly as possible on a level with the upper border of the os calcis; a point which the surgeon can determine, if the dorsum of the foot is in a natural state, by feeling the pit in which the extensor brevis digitorum arises. Another incision is then to be drawn vertically across the sole, commencing near the anterior end of the former incision, and terminating at the outer border of the grooved, or internal surface of the os calcis, beyond which point it should not extend, for fear of wounding the posterior tibial vessels. If more room be required this vertical incision may be prolonged a little upwards, so as to form a +.[1] The bone being now denuded, by throwing back the flaps, the first point is to find, and lay open, the calcaneo-cuboid joint; and then the joints with the astragalus. The connections between these two bones constitute the principal difficulty in the operation on the dead subject; but, as has been already stated, these joints will frequently be found to have been destroyed in cases of disease. The calcaneum having been separated thus from its bony connections by the free use of the knife, aided if necessary by the lever, lion-forceps, &c., the soft parts are next to be cleaned off its inner side with care, in order to avoid the vessels, and the bone will then come away. The flaps are to be closed lightly, with one or two points of wire-suture, over the large gap left by the excision.

Subperiosteal excision.

M. Ollier describes an operation by which the os calcis can be removed subperiosteally without the division of any tendons, except the tendo Achillis. An angular flap is made by an incision running horizontally along the lower outer border of the bone, and vertically along the outer border of the tendo Achillis. Then the periosteum and the parts above it, including the peronei tendons, are peeled off the bone. Next the attachment of the tendo Achillis and the periosteum are detached from the tuberosity of the os calcis. Then the joints are opened, and the inside of the bone is cleaned, and so its removal is completed. I have only practised this operation once, and then the result seemed to me less perfect than after the ordinary operation.[2]

After recovery, the only mark of deformity in the foot is an elevation of the heel proportionate to the size of the bone removed.

Excision of the astragalus.

Excision of the astragalus.—The astragalus is easily removed by making a curved incision from one malleolus to the other, something like that made at the beginning of Syme's amputation. The ankle-joint is then to be laid freely open, and the whole upper part of the diseased bone thus exposed. Then the ligaments connecting it to the scaphoid are to be severed, and the bone is to be levered up, when the interosseous ligament connecting it with

[1] I have always divided the tendons of the peroneus longus and brevis. They can, of course, be dissected out and held aside with a blunt hook, but I have not observed any bad effects from their division.

[2] See 'Clin. Soc. Trans.' vols. viii. xi.

the os calcis will, if entire, be felt, and can be readily divided. All that is then necessary to complete the operation is to clean the back part of the bone, which should be done with care, in order to avoid injury to the tendons and vessels which lie near it. I have had several cases in children, and have seen one in an adult in whom a very useful foot was left.

The bone may also be removed by two lateral incisions similar to those used in excision of the ankle. This method avoids the injury to the tendons and vessels incidental to the former, but is more laborious.

Excision of the astragalo-calcanean joints.

Mr. Annandale has lately devised and performed an operation by which the joints between the astragalus and os calcis can be excised in those cases where disease of the tarsus begins, as it often does in that situation. A free incision is made from the tip of either malleolus to the cuboid joint on the one side, and along the tendon of the tibialis posticus to the scaphoid bone on the other. The tendons and vessels are thrown back, and the periosteum raised from the bones with raspatories. Thus the two joints are fully exposed, and can be removed with chisel and mallet. If there be any disease in the fossa between the two joints, it can be gouged out. Mr. Annandale refers to cases in which the operation has been successfully performed.[1]

Other excisions in the foot.

No formal directions are required for excising the other tarsal bones. The soft parts are to be thrown aside by crucial incisions, radiating from the sinuses which lead to the diseased bone, and the latter removed; care being taken, in all cases where it is possible, to excise the whole bone with the articulating surfaces.

The metatarsal bone of the great toe is very often diseased; and from its large size disease may go on in its substance for a long period without affecting any other bone. In such cases, after a sufficiently patient trial of the appropriate constitutional treatment, with rest, it is proper to expose the disease; and if this is found to include the greater part of the bone, then the best course is to remove the whole, with both its articular surfaces. This may be readily done by making an incision over the whole length of the bone, joined by shorter perpendicular cuts in front and behind, and thus turning back small rectangular flaps including the whole length of the bone. It is better to commence by severing it from the cuneiform bone, as in dividing it from the phalanx the plantar arch will most likely be wounded, and the bleeding may prove somewhat embarrassing; whereas if the artery be not divided till the bone is removed, there is no difficulty in tying it. No splint is required. The great toe sinks down somewhat towards the tarsus, but the foot is as useful in progression as before.

It seems hardly worth while to expend space on the description of such rare operations as the excision of the whole or greater part of the tarsus[2] of the tarso-metatarsal joints,[3] or of portions or the whole of the shaft of the long bones (see p. 416), or of the ribs or sternum. They are very rarely practised, and in the latter case especially the indications for their performance should be narrowly scrutinised, since they are by no means free from danger, nor at all certain to attain the end in view, which is to remove the whole disease and thereby take away permanently what must always be a source of irritation to the subjacent viscera.

[1] 'Ed. Med. and Surg. Journ.' June 1877.

[2] On excision of the whole tarsus, see Macnaughton Jones, 'Lancet,' July 9, 16, 1881; and Conner, 'Am. Journ. Med. Sci.' Oct. 1883.

[3] See a case reported by me in the 'Clin. Soc. Trans.' vol. v. p. 207. Disease recurred in the tarsus in this case eight years afterwards, and the foot was amputated.

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